DOCUMENT RESUME

ED 333 087 UD 028 110

AUTHOR Webb, Norman L.; And Others
TITLE The Urban Mathematics Collaborative Project: Report to the Ford Foundation on the 1987-88 School Year. Program Report 89-1.
INSTITUTION Wisconsin Center for Education Research, Madison.
SPONS AGENCY Ford Foundation, New York, N.Y.
PUB DATE Mar 89
NOTE 400p.; For related documents, see UD 028 111-112.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC16 Plus Postage.
DESCRIPTORS College School Cooperation; *Collegiality; Cooperation; *Cooperative Programs; Elementary Secondary Education; *Mathematics Teachers; *Professional Development; Program Evaluation; School Business Relationship; *Teacher Improvement; *Urban Schools
IDENTIFIERS *Collaboratives

ABSTRACT

This report documents and evaluates the activities of the Urban Mathematics Collaborative (UMC) project during the 1987-88 school year. UMC seeks to improve mathematics education in inner-city schools and identify new models for the professional development of mathematics teachers by supporting collaboration among mathematics teachers and mathematicians from institutions of higher learning and industry. Teachers are encouraged to identify with and participate in a broad-based local mathematics community. The project is currently operating in 11 cities across the country. A variety of qualitative and quantitative methods were used to evaluate the project. The following summary findings are presented: (1) the project has been successful in drawing teachers into more active participation in professional activities and events; (2) participants report increased collegial support among teachers; (3) participants are more willing to avail themselves of opportunities for professional enrichment and are more open to new ideas and approaches; (4) participants are taking the initiative in introducing and implementing new ideas in their schools; (5) the project's impact on the relationships between teachers and mathematicians in business and higher education is difficult to assess; and (6) the project has improved the relationship between teachers and supervisors. Descriptions of the 11 UMC collaboratives are included. A list of 10 references and summary reports from the 11 collaboratives are appended. (FMW)

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Elizabeth M. Fadell, and James A. Middleton

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Wisconsin Center for Education Research
School of Education, University of Wisconsin - Madison

Program Report 89-1

THE URBAN MATHEMATICS COLLABORATIVE PROJECT: REPORT TO THE FORD FOUNDATION ON THE 1987-88 SCHOOL YEAR

Norman L. Webb, Susan D. Pittelman, Thomas A. Romberg
Allan J. Pitman, Elizabeth M. Fadell, and James A. Middleton

Report from
the Urban Mathematics Collaborative Documentation Project

Wisconsin Center for Education Research
School of Education
University of Wisconsin
Madison, Wisconsin

March 1989

We gratefully acknowledge the assistance of Dianne Paley, Deborah Stewart, Kay Schultz, Lorene Folgert, and Jana Hinken in the preparation of this report.

The research reported in this paper was supported by the Ford Foundation and by the Wisconsin Center for Education Research, School of Education, University of Wisconsin-Madison. The opinions expressed in this publication are those of the authors and do not necessarily reflect the views of the Ford Foundation or the Wisconsin Center for Education Research.

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I. INTRODUCTION

In 1984, the Ford Foundation initiated the Urban Mathematics Collaborative (UMC) project to improve mathematics education in inner-city schools and to identify new models for meeting the ongoing professional needs of teachers. In February, 1985, the Ford Foundation awarded five grants to establish urban mathematics collaboratives in Cleveland, Minneapolis-St. Paul, Los Angeles, Philadelphia and San Francisco. In addition, the Ford Foundation established a Documentation Project to monitor the activities of the new collaboratives and a Technical Assistance Project (TAP) to serve as a source of information for the collaborative projects (Romberg & Pitman, 1985). During the next eighteen months, UMC projects were funded in Durham, Pittsburgh, San Diego, St. Louis, Memphis, and New Orleans, bringing to eleven the total number of urban mathematics collaboratives (Romberg, Webb, Pitman, & Pittelman, 1987; Webb, Pittelman, Romberg, Pitman, & Williams, 1988). In August, 1987, an Outreach Project was funded to publicize and expand the UMC effort. A map of the UMC project appears in Figure 1.

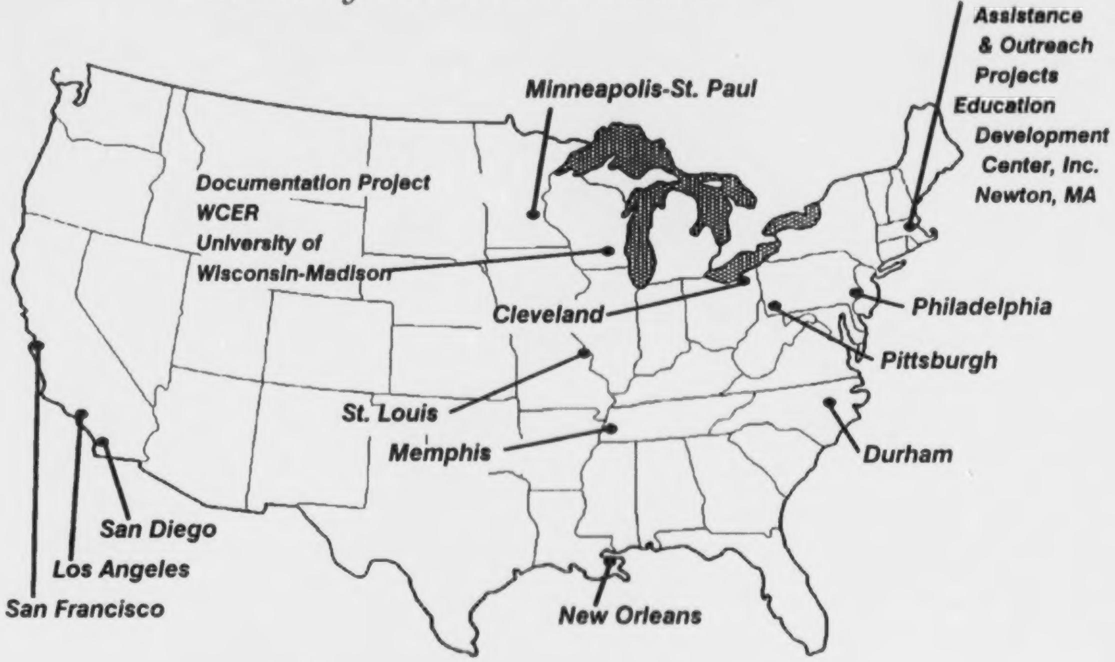
In each of the eleven cities, the UMC project continues to support collaboration among groups of mathematicians from high schools, institutions of higher education, and industries, and to encourage teacher membership and participation in a broad-based local mathematics community. Since the project's inception in 1984, it has become clear that the teacher is and will remain the hub of the educational process. But it also has become evident that many teachers--and especially those in inner-city schools--are overworked, lacking in support and material resources, and isolated from their colleagues, from other professionals, and from the rapidly changing field of mathematics.

The collaborative project remains rooted in the premise that collegiality among professional mathematicians can reduce teachers' sense of isolation, foster their professional enthusiasm, expose them to a vast array of new developments and trends in mathematics, and encourage innovation in classroom teaching. The Ford Foundation's concomitant commitment of human and financial resources provides a support network to allow such collegiality to take place.

An important element of the network is the administrative support provided by the Technical Assistance Project, the Outreach Project, the Documentation Project and the Ford Foundation. The Technical Assistance Project (TAP) was established in September, 1985, to provide a broad range of technical assistance to the Urban Mathematics Collaborative project as a whole, as well as to the eleven individual collaboratives. The project is directed by Dr. Mark Driscoll at the Education Development Center, Inc. (EDC), a non-profit research and development organization located in Newton,

The Urban Mathematics Collaborative Project

Funded by The Ford Foundation


Technical Assistance & Outreach Projects
Education Development Center, Inc.
Newton, MA
Minneapolis-St. Paul
Documentation Project
WCER
University of Wisconsin-Madison
Cleveland
Philadelphia
Pittsburgh
St. Louis
Memphis
Durham
San Diego
Los Angeles
San Francisco
New Orleans

- **Cleveland Collaborative for Mathematics Education (C^2ME)**
  Cleveland, Ohio
- **Durham Collaborative: The Durham Mathematics Council**
  Durham, North Carolina
- **Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC)**
  Los Angeles, California
- **Memphis Urban Mathematics Collaborative**
  Memphis, Tennessee
- **New Orleans Mathematics Collaborative (NOMC)**
  New Orleans, Louisiana
- **Philadelphia Math Science Collaborative**
  Philadelphia, Pennsylvania
- **Pittsburgh Mathematics Collaborative**
  Pittsburg, Pennsylvania
- **St. Louis Urban Mathematics Collaborative**
  St. Louis, Missouri
- **San Diego Urban Mathematics Collaborative**
  San Diego, California
- **San Francisco Mathematics Collaborative**
  San Francisco, California
- **Twin Cities Urban Mathematics Collaborative**
  Minneapolis-St. Paul, Minnesota

Figure 1. The Ford Foundation National Network of Urban Mathematics Collaboratives.

Massachusetts. Under his direction, the project has provided each site with assistance in solving local problems and identifying local resources; provided encouragement as well as financial support for collaborative members to participate in national and regional symposia, workshops and pilot projects; kept the sites informed of the status and direction of mathematics curriculum reform; facilitated communication and fostered networking among the eleven collaboratives; and established priorities for the project such as focusing on equity and on the NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989).

The Outreach Project was created in fall, 1987, to complement the efforts of the collaboratives by disseminating information about the unique nature of the local initiatives, and by providing the collaboratives with a national voice in the arena of education policy and reform. A third responsibility of the outreach project is to offer assistance to other communities seeking to replicate or adopt important features of the UMC model. The Outreach Project is directed by Dr. Brian Lord. Like the Technical Assistance Project, the Outreach Project is administered by the Education Development Center.

The Documentation Project at the Wisconsin Center for Education Research at the University of Wisconsin-Madison was established in 1984 to record the progress of each collaborative in defining, redefining, and refining its concerns. In December, 1987, a case study component of the project was initiated to conduct case studies on one or two teachers at each site. Six sites were studied during 1987-88; the case studies at the five remaining sites will be conducted during 1988-89.

The efforts of each project, as well as those of the Ford Foundation itself, merit study for three reasons. First, each project and the Ford Foundation need to be kept informed about what is happening; ongoing activities, the strategies employed, and the effects of those activities on the professional lives of teachers and other project participants need to be documented in order to be shared. Second, it is important for the projects, the Ford Foundation, and the educational policymaking community to understand the characteristics and relationships inherent within each project. Because changes occur over time, the activities, the actual changes in behavior, the anticipated and unanticipated outcomes, and the impediments encountered under varying circumstances must be identified and studied. Third, although each site is unique, the data will enable us to identify project activities and strategies that can be generalized to different settings. By encouraging mathematics teachers to act as self-directed professionals, the collaboratives are generating strategies that can be used with teachers of all subjects.

The Documentation Project provides each of the collaboratives with a broader view of its place in the overall UMC project. It offers the projects an attentive audience as well as information and comments on how other sites are dealing with similar issues, and advice on problems common to all sites. The staff also provides professional expertise in mathematics education when such input is requested.

The Ford Foundation Program Officer, Dr. Barbara Scott Nelson, has been a visible spokesperson for the collaborative projects. She has visited with key personnel at each site, bringing the prestige and power of the Ford Foundation to each project's initial efforts to gain local support. She has been a mentor, mediator and a problem-solver, consistently supporting the collaborative projects as they strive toward the collaborative vision that guides all of the efforts of the UMC project. Dr. Nelson's involvement, however, is tempered by the goal and expectation of the Foundation that the collaboratives will become self-sufficient over time and will continue to serve teachers long after Ford funding terminates.

The urban mathematics collaboratives have assembled local resources--both financial and human--and have configured them in a variety of ways to explore new modes of professionalism for teachers and new kinds of relationships between high school mathematics teachers and the professional users of mathematics in higher education and in business. Considered individually, each collaborative is a unique, locally controlled project. But viewed as components of a wide-reaching national network, they comprise an efficient, cost-effective and comprehensive field experiment that is enhancing participating teachers' knowledge and professionalism as it serves as a testing ground for new modes and approaches to larger issues of professional enrichment and subject-area expertise.

Consonant with the Foundation's original intent, each of the eleven collaboratives has been encouraged to develop as a unique program, drawing on local resources, exploiting local strengths, and addressing local weaknesses. As the effort continues, the UMC project will focus more specifically on the effects of the developing networks on the professional lives of the participating teachers and on the identification of issue-based outcomes. The Foundation's intent in the UMC effort is in keeping with the recommendations of the Conference Board of the Mathematical Sciences (1984):

> The Conference recommends the establishment of a nationwide collection of local teacher support networks to link teachers with their colleagues at every level, and to provide ready access to information about all aspects of school mathematics. (p. 5)

The broad sense in which the term *colleague* is used is exemplified by the objectives "strongly endorsed by the Conference":

> - to extend the sense of professionalism among teachers by building a support system that links them to colleagues in the mathematical sciences, inside and outside of the schools;
>
> - to provide teachers at all levels with colleagues upon whom they can call for information concerning any aspect of school mathematics; and
>
> - to enable teachers to enlarge their views of mathematics, their source of examples, and their repertoire of classroom skills in communicating mathematics. (CBMS, 1984, p. 15)

Since the project's inception in 1984, the Foundation has been increasingly successful in its aim to involve participating teachers at each site in a diverse set of activities and interactions that are planned and implemented to reflect the concerns and professional priorities of the teachers, as well as mathematicians from educational, cultural and business institutions. In all cases, these activities and interactions have been designed to ensure that teachers are viewed as professionals who bring to the exchange their unique viewpoints, perspectives and experiences, rather than as clients who "receive" information from other partners in the relationship.

Data about the collaboratives have been collected from a variety of sources, including:

1. the directors and coordinators of each project;
2. the on-site observers from each project (reflecting the teachers' perspectives);
3. visits by the staff of the Documentation Project;
4. discussions with teachers;
5. joint meetings with personnel from the Ford Foundation, the Technical Assistance Project and the Outreach Project;
6. meetings of the project directors and of the project coordinators;
7. meetings of representatives of all of the projects; and
8. surveys administered to participating teachers.

This report presents an overview of the efforts of the UMC project as a whole, as well as a brief description of each of the collaboratives. The Appendix of the report includes a detailed progress report for each of the collaborative projects for the 1987-88 school year.

II. PROJECT DESCRIPTIONS

A brief description of each of the eleven Urban Mathematics Collaboratives is presented in this section. (A more detailed report of each collaborative is appended to this paper.)

Cleveland Collaborative for Mathematics Education (C^2ME)

Director: Ms. Paula C. Fay (through September, 1987)
Ms. Barbara Patterson (appointed February 29, 1988)
Acting Director: Mr. Joseph Flynn (October, 1987 to February, 1988)
Coordinator: Ms. Suzanne Haggerty (through February, 1988)
Ms. Charniece Buford (appointed June 27, 1988)
On-Site Observer: Mr. Robert Seitz
Funding Agent: The Cleveland Education Fund
Date of Initial Funding: February 1, 1985

The Cleveland Collaborative for Mathematics Education (C^2ME) was one of the five original collaboratives established in 1985. The collaborative, which serves the approximately 200 secondary mathematics teachers in the Cleveland Public Schools, is administered through the Cleveland Education Fund.

C^2ME's purpose is to enhance the quality of secondary mathematics education in the Cleveland Public Schools by finding new ways to integrate community resources into the teaching process and by defining new models for meeting the continuing professional needs of teachers. The collaborative has defined its mission as enhancing the professionalism and effectiveness of intermediate and secondary school mathematics teachers in the Cleveland Public Schools by providing opportunities for collegiality, training/professional growth, and curriculum development.

An Advisory Board and a Teacher Advisory Board provide input to the collaborative's director and project coordinator. The Advisory Board, which oversees the operation of C^2ME, is comprised of representatives of science, education, and business, including nine mathematics teachers from the Cleveland Public Schools. The Teacher Advisory Board was established in early 1986 to assist the collaborative in developing its long-range plans and future activities. Teachers were selected to serve on the board based on their participation in C^2ME's programs and on their dedication to excellence in mathematics education in the Cleveland Public Schools. In fall, 1987, membership in the Teacher Advisory Board was expanded from eleven to eighteen teachers.

During the 1987-88 school year, C^2ME offered a wide variety of activities designed to provide teachers with opportunities for training, information, collegiality, and networking with their colleagues, as well as with mathematicians from business, industry, and higher education. The collaborative sponsored a series of dinner symposia hosted by local industry, served as a conduit for the funding of AETNA Math Clubs, initiated and supported mathematics contests, and provided funding for teachers to attend local workshops, including events at Oberlin and Baldwin Wallace, as well as regional and national workshops and conferences. In addition, the collaborative continued to publish its own quarterly newsletter; encouraged participation in Cleveland's Teacher Internship Program; helped to facilitate the John Carroll University scholarship program, through which teachers receive awards to cover the cost of college coursework; and provided small grants to teachers in the Cleveland Public Schools. The collaborative's multipurpose Resource Center continued to offer a variety of services and support to Cleveland mathematics teachers.

Durham Collaborative: The Durham Mathematics Council

Director: Dr. J. Keith Brown
Executive Director: Dr. Jo Ann Lutz
On-Site Observer: Ms. Betty Peck
Funding Agent: The North Carolina School of Science and Mathematics
Date of Initial Funding: August 1, 1985

The Durham Mathematics Council was established in August, 1985, as the sixth collaborative in the Urban Mathematics Collaborative project. The collaborative, which serves 139 secondary and middle school mathematics teachers in the Durham city and county school systems, is administered through the North Carolina School of Science and Mathematics (NCSSM).

Since its inception, the project has identified five major areas for involvement to enhance the professional growth of secondary school mathematics teachers. They are: enhancement of knowledge about local mathematics applications; expansion of currently limited opportunities for teachers to travel; support for teachers' growth as mathematicians; provision of opportunities for professional collegiality; and combating "burnout" and loss of professional self-esteem.

The collaborative's Board of Directors assists the project director and the executive director in guiding the project's focus and activities. The sixteen-member Board is comprised of representatives from area businesses, higher education, and the city and county schools, including two teachers. The Steering Committee, comprised of one teacher from each school, was established to provide a direct link between the teachers and the collaborative administration.

The programs of the Durham Mathematics Council are designed to encourage junior high and senior high school mathematics teachers to communicate with their colleagues working in all areas of professional mathematics. During the 1987-88 school year, the Council sponsored a wide variety of activities for Durham teachers, including workshops and seminars, a reception and a dinner meeting, and meetings of teachers in four subject areas. DMC also helped to organize and promote meetings of the Triangle Math Club and played an integral role in conducting the national 1987 NCSSM Summer Workshop. The DMC teachers were very instrumental in planning, designing and assuming leadership roles in the Mathematics Reform and Teacher Professionalism Conference held in Durham in June, 1988. In addition, DMC awarded more than fifty travel grants to enable members of the council to attend state, regional and national conferences, and fourteen mini-grants to fund the purchase of classroom materials, the development of new curriculum materials, and summer study. The collaborative also expanded the scope and quantity of the materials available through the Teacher Resource Center and continued to publish its own newsletter approximately every three months.

Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC)

Executive Director: Ms. Peggy Funkhouser
Project Director: Ms. Toby Bornstein
On-Site Observer: Mr. Richard Curci
Funding Agent: Los Angeles Educational Partnership
Date of Initial Funding: February 1, 1985

The Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC) was organized in mid-1986 as a result of a restructuring and reorientation of the Los Angeles Urban Mathematics Collaborative, which was established in 1985 as one of the five original collaboratives. LAUM/SC is the official title of the fifty-seven-member Advisory Committee, which reports to the funding agent, the Los Angeles Educational Partnership (LAEP). The Advisory Committee provides direction to LAEP on the operation of four programs: +PLUS+ (Professional Links with Urban Schools), Mathematics/Science Teacher Fellowship, Model Technology Project, and Target Science. The Advisory Committee's membership includes lead teachers from +PLUS+, and representatives of participating school districts, the County Office of Education, foundations, museums, corporations, professional organizations, and post-secondary institutions.

The collaborative serves not only the entire Los Angeles Unified School District (LAUSD) but several nearby districts as well. In light of its massive target population, the collaborative's +PLUS+ program focused first on the mathematics departments in three high schools; during the collaborative's first year, the departments in these schools formed +PLUS+ teams with local business and post-secondary associates. Departments from only two of these schools remained in the program after one year. In spring, 1987, the +PLUS+ program was expanded to include five additional schools and in spring, 1988, eight more departments were added, bringing the total number of active +PLUS+ departments at the end of 1987-83 to fifteen. Each of these departments is represented on the Teachers' Council, which meets once a month during the school year as a forum for departmental leadership. During the past year, the Council has assumed an active role in directing the course of the teachers' professional development.

The +PLUS+ program's goal is to broaden teachers' mathematical horizons by encouraging them to interact with their colleagues in a mathematics resource network, and to help them relate the world of work to the mathematics curriculum. The +PLUS+ initiative involves two major efforts. One component in 1987-88 included the mathematics departments in fifteen high schools. In 1987-88, sixty high schools from four targeted school districts--Los Angeles Unified, El Monte, Inglewood, and Pasadena--were eligible for this program.

The +PLUS+ teams in each of the fifteen target schools prepare and execute their own plans for improved mathematics programs. Considerable effort has been expended in building these teams, with the goal of fostering and consolidating departmental cohesion. As a prerequisite to financial support, departments in the target schools agreed to define needs, explore resources, and develop a program of activities. The second component, workshops, is directed toward mathematics teachers. Teachers from all Los Angeles County Schools are eligible to attend; however, greater emphasis is given to encouraging teachers from the four targeted school districts to participate. Within the structure of the +PLUS+ program, steering committees comprised of teachers and business and college associates plan workshops for all teachers in the Los Angeles area.

The collaborative expanded its Teacher Associate Pairs (TAP) program to provide more teachers the opportunity to interact with mathematicians from the "real world" and, in the summer of 1987, piloted IISME (Industry Initiatives in Science and Mathematics Education), through which seven teachers worked in industry. In addition, Televenture, the electronic bulletin board which allows free exchange of information among the mathematics teachers at +PLUS+ schools, was expanded to include several science teachers and district instructional specialists. The collaborative also funded attendance of +PLUS+ teachers at several local and national workshops and conferences.

Memphis Urban Mathematics Collaborative

Executive Director: Mr. Herman Ewing
Project Coordinator: Ms. Nancy Gates
On-Site Observer: Ms. Rita Ross
Funding Agent: Memphis Urban League, Inc.
Date of Initial Funding: September 1, 1986

The Memphis Urban Mathematics Collaborative, established in September, 1986, was the last of the eleven collaboratives to join the UMC project. The collaborative serves the approximately 350 mathematics teachers in the Memphis City Schools, but it has focused its efforts in particular on the mathematics teachers in the fifty-three middle, junior high and senior high schools. The collaborative is administered through the Memphis Urban League, Inc.

The Memphis collaborative's primary goal is to create and promote an environment in which mathematics teachers can develop an individual and collective sense of professionalism through a variety of enrichment activities, and establish beneficial relationships with mathematics professionals in the business and university sectors.

The collaborative's organizational structure has evolved gradually since 1986. The collaborative is governed by a twenty-member Advisory Committee comprised of five teachers, seven mathematics professors and representatives from higher education, five from business and industry, two from the school district administration, and one from the Urban League. A Teacher's Committee of fourteen teachers serves as a sounding board for teachers' views about the activities the collaborative should be planning. A six-member Project Committee composed of teachers, representatives from business and higher education, and the MUMC coordinator plans the implementation of programs. The committee met several times during the school year. Late in 1987-88, a Permanence Committee was established to begin work on the permanence proposal to the Ford Foundation; its first meeting was scheduled in July, 1988.

During the 1987-88 school year, the collaborative offered a wide array of activities, programs and services to mathematics teachers in the Memphis City Schools. These included a summer workshop series, a Swap-Shop workshop series, a grant-writing workshop, dinner meetings with representatives from industry, a year-end reception and summer internships. In addition, the collaborative established a Speakers Bureau, distributed a directory to all Memphis City Schools Mathematics teachers, and initiated the publication of its biannual newsletter. The collaborative also encouraged teachers to take advantage of professional opportunities offered by other organizations, including professional conferences and grant programs.

New Orleans Mathematics Collaborative (NOMC)

Director: Ms. Constance Barkley (interim director through June, 1988)
Coordinator: Dr. Olympia Boucree
On-Site Observer: Ms. Aldonia Winn
Funding Agent: The Metropolitan Area Committee (MAC) Foundation
Date of Initial Funding: September 1, 1986

The New Orleans Mathematics Collaborative, established in 1986, was the tenth of the eleven collaboratives to be funded by the Ford Foundation. The collaborative, which serves the approximately 150 senior high school mathematics teachers in the New Orleans Public Schools, is one of four programs coordinated by the Metropolitan Area Committee Education Fund. In addition, 136 middle and junior high school mathematics teachers are invited to attend some of the large group affairs.

The collaborative's aim is to enhance the professional development of mathematics teachers and to enrich the teaching of mathematics in New Orleans' public secondary schools. To accomplish these goals, the collaborative has provided teachers with opportunities to develop networks with mathematicians from business and higher education, to work in collaboration with other teachers and mathematicians, to stay abreast of new developments in mathematics and teaching, and to understand the importance of mathematics in "real world" settings.

The collaborative is governed by a twenty-member Steering Committee comprised of teachers, district administrators, and representatives from the teachers' union, businesses, universities, and the Louisiana Science Centre. The committee chairman, who is Chief Executive Officer of Shell Offshore, Inc., also sits on the MAC Education Fund Board. Four subcommittees--symposia, site visits and internships, workshops, and the newsletter--oversee collaborative activities. This year a Teacher's Advisory Council was established. The Council, which is composed of a teacher representative from each high school, meets on a regular basis to discuss ways to maximize participation in NOMC. The collaborative also is working with Southern University, the Urban League, and the American Association for the Advancement of Science to establish a Community Learning Center, which will help minorities and women master computer skills to enhance their performance in mathematics and the sciences.

During the 1987-88 school year, the New Orleans Mathematics Collaborative sponsored a wide variety of activities, including a dinner symposium series, six site visits to local businesses and industries, and several workshops. The collaborative also initiated an Industry Internship Program, encouraged teachers to apply for mini-grants, and sponsored teachers' attendance at a variety of regional and national conferences. In addition, the collaborative continued to publish its own newsletter.

Philadelphia Math Science Collaborative

Director: Dr. Wayne Ransom
Coordinator: Ms. Sue Stetzer
On-Site Observer: Ms. Joyce Neff
Funding Agent: The Franklin Institute
Date of Initial Funding: February 1, 1985

The Philadelphia Math Science Collaborative was formed in fall, 1986, through a restructuring and reorientation of the Philadelphia Mathematics Collaborative, one of the original five collaboratives. The collaborative, which serves mathematics and science teachers in the School District of Philadelphia, is administered through the Franklin Institute. During the 1987-88 school year, the number of target schools increased from six to nine.

The goals of the Philadelphia Math Science Collaborative are to promote teacher leadership and team building and to contribute to a vision of mathematics teaching in the future. Specifically, the collaborative hopes to: (l) develop, evaluate, and document the position of an in-school collaborator who would facilitate communication and serve as a catalyst for change and (2) increase teacher participation in extramural professional development programs which offer partnerships between teachers and their colleagues in academia and industry; opportunities to enhance knowledge, skills, and professionalism; and new ideas for mathematics instruction. The collaborative also hopes to develop a model for documenting the impact these two programs will have upon the quality of teachers' professional lives.

The collaborative is governed by three committees, which comprise its Council. The committees are composed of teachers from the target schools, as well as representatives from various local colleges, businesses, the school district, PRISM (Philadelphia Renaissance in Science and Mathematics), and professional organizations. The Steering Committee is responsible for the overall governance of the collaborative. The Program Planning Committee is responsible for planning the collaborative's programs while the Communications Committee is attempting to improve communications between the various constituent groups within the collaborative.

In addition to encouraging teachers to participate in the many programs provided for them by other organizations in the Philadelphia area and providing teachers in the target schools free memberships in their local professional organizations, the collaborative has offered several activities during the 1987-88 school year aimed specifically at the targeted teachers. These programs include grants which enable teachers to attend professional meetings, workshops, and seminars; a dinner meeting to improve communication between mathematics and science teachers; pilot programs for computer software; assistance for teachers wishing to apply for PRISM grants; monthly departmental meetings, which have included guest speakers and reviews of educational software; after-school programs to expand teachers' visions of mathematics and science beyond the classroom; a monthly calendar and newsletter; ACCESS, a network of support materials for teachers of Mathematics in Application; and a clearinghouse service that keeps teachers notified of resources for classroom use.

Pittsburgh Mathematics Collaborative

Project Coordinator: Dr. Leslie Salmon-Cox
Assistant Project Coordinator: Ms. Barbara Bridge
On-Site Observer: Ms. Rosemarie Kavanagh
Funding Agent: Allegheny Conference on Community Development
Date of Initial Funding: September 1, 1985

The Pittsburgh Mathematics Collaborative, established in 1985 to serve the 114 high school mathematics teachers in the Pittsburgh public schools, was the seventh collaborative to be funded. The collaborative is administered through the Allegheny Conference Education Fund, which is administered by the Allegheny Conference on Community Development.

Six goals provide a focus for the collaborative's efforts: to overcome teachers' isolation through increased opportunities for interaction; to educate the community about the professional nature of high school mathematics teachers; to enhance teachers' knowledge of mathematics applications; to provide opportunities for professional self-enhancement; to provide opportunities for teacher recognition; and to provide time for teacher interaction, work, and professional development. These goals are envisioned as positive steps toward institutionalization of structures and processes that will foster teacher professionalism and that will be decreasingly reliant on external administration and facilitation.

Collaborative governance is shared among the twenty-seven-member Steering Committee and its five-member Executive Committee, called the "First Tuesday Committee," and the department chairs from each of the twelve high schools. The Steering Committee, comprised of teachers, school district administrators, college and university faculty members, and representatives from various community councils, corporations, and foundations, meets annually to discuss the collaborative's direction and activities. The department chairs meet monthly during the school year to plan and evaluate specific activities. The department chairs also serve as the major communication channel between the collaborative and the teachers. The Executive Committee, comprised of collaborative staff and leaders from supporting agencies, meets the first Tuesday of each month to plan and review the daily operations of the collaborative.

During the 1987-88 school year, the Pittsburgh Mathematics Collaborative offered a variety of activities and programs designed to enhance professionalism and collaboration among teachers and professionals in the mathematical sciences, as well as to provide teachers with information about mathematics applications. These included receptions, a dinner meeting, participation in curriculum development committees, in-service programs, and a newly created math-intensive partnership program. The collaborative also published a newsletter, GRAPHiti, for secondary mathematics teachers, and encouraged teachers to take advantage of professional opportunities offered by related organizations, such as professional conferences and professional enrichment grants.

St. Louis Urban Mathematics Collaborative

Director: Ms. Judith Morton
Project Coordinator: Ms. Karen McCarthy (appointed October, 1987)
On-Site Observer: Mr. James Richmond (through March, 1988)
Mr. Donald Thompson (appointed April 1, 1988)
Funding Agent: Mathematics and Science Education Center
Date of Initial Funding: April 15, 1986

The St. Louis Urban Mathematics Collaborative was one of the four collaboratives established in 1986. The collaborative, which serves the 104 mathematics teachers and fourteen computer science teachers in the St. Louis Public School District, is administered through the Mathematics and Science Education Center. The Mathematics and Science Education Center, which was established in fall, 1986, assists schools and districts to provide quality education in mathematics and science.

The primary goals of the collaborative focus on providing teachers with opportunities: to explore business-, industry-, and university-based resources, and to determine how these resources may assist them in their professional growth and classroom instruction; to develop and implement staff training programs for themselves and for their peers; to improve communication and information exchange among mathematics teachers, both within and across schools; and to promote recognition of accomplishments and quality performance among all mathematics teachers and students. These goals were derived from secondary mathematics teachers' expectations that the collaborative would improve their knowledge of mathematics and its applications, and would increase their communication, collegiality, instructional expertise, and feelings of professionalism.

The collaborative operates under the direction of a Collaborative Council, consisting of twelve teachers from the St. Louis Public Schools; representatives from the academic and business communities; the district's three mathematics supervisors; the director of the Partnership Program; a representative of the school district's Division of Technology Development; and the collaborative's coordinator and director. The Council meets once each month to discuss, plan, and evaluate collaborative events. Decisions are made by Council vote.

During the 1987-88 school year, the collaborative sponsored a wide variety of activities for high school mathematics teachers in the St. Louis Public Schools, including workshops and seminars, a dinner symposium, a mathematics fair, a mathematics contest, site visits to businesses, summer internships and three social gatherings. The collaborative also supported events and activities sponsored by the Mathematics and Science Education Center, the Mathematics Educators of Greater St. Louis and other local agencies. In some cases, the collaborative provided funding for teachers to attend local seminars and national workshops and conferences.

San Diego Urban Mathematics Collaborative

Director: Prof. Alma Marosz
Co-Director: Dr. Mary Koehler (appointed September, 1987)
Coordinators: Mr. Frank Holmes
Ms. Beth Schlesinger (through June, 1987);
Ms. Jean Childs-Moore (appointed September, 1987)
On-Site Observer: Dr. Sharon D. Whitehurst
Funding Agent: San Diego State University Foundation
Date of Initial Funding: April 15, 1986

The San Diego Urban Mathematics Collaborative, established in spring, 1986, is administered through the San Diego State University Foundation. During the 1987-88 school year, the collaborative served approximately 120 mathematics teachers from nine targeted schools: six senior high schools and three feeder junior high schools in the Sweetwater Union High School and the San Diego Unified School districts, an increase of three schools over the previous year.

The collaborative's primary goal is to improve the professional lives of mathematics teachers in the San Diego area by reducing their tendency to work in isolation and by increasing the contacts that foster mutual support, professional growth, and involvement with the larger professional mathematics community.

The collaborative is governed by a project director, a co-director, two project coordinators, and the Executive Committee, which consists of mathematics specialists from the city, teachers who were involved in writing the proposal, and teachers from the targeted schools, as well as faculty members from San Diego State University and the collaborative director, co-director, and coordinators. The major thrust of the Executive Committee's efforts has been directed toward instilling in teachers a sense of project ownership. The Executive Committee meets monthly to advise the collaborative staff on future plans, provide feedback on activities, and offer insights into teachers' needs.

In addition to encouraging teachers to take advantage of a wide array of local resources, the collaborative hosted a second annual evening retreat, a workshop series based on the *California Mathematics Framework*, an NCTM *Standards* workshop, a reception and screening of the movie "Stand and Deliver," and an industry applications tour. The collaborative also has paid the $6.00 membership dues of the Greater San Diego Mathematics Council (GSDMC) for mathematics teachers in the three new targeted schools and $3.00 toward membership for teachers in the six continuing schools; encouraged and helped to facilitate teachers' applications for grants and scholarships; and offered stipends to teachers to enable them to attend several conferences and workshops, including the annual fall conference of the Southern Section of the California Math Council, the Annual Greater San Diego Math Conference, the national NCTM conference, the Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy in New Hampshire, and the Mathematics Reform and Teacher Professionalism conference in Durham, North Carolina.

San Francisco Mathematics Collaborative

Executive Director: Ms. Gladys Thacher
Director of Development & Community Outreach: Ms. Janice E. Toohey
Project Director: Ms. Wandaline Perelli (through June, 1987)
Mr. Robert Marcucci (appointed October, 1987)
On-Site Observer: Ms. Joanne Pamperin
Funding Agent: San Francisco Education Fund
Date of Initial Funding: February 1, 1985

The San Francisco Mathematics Collaborative was one of the five original collaboratives established in 1985. The collaborative, which serves the 235 mathematics teachers in the San Francisco Unified School District, is administered through the San Francisco Education Fund.

The goal of the San Francisco Mathematics Collaborative is to show teachers "how mathematics is imbedded in the world around us, while being sensitive to the needs and interests of the teachers involved in the program." In light of this goal, collaborative efforts focus on developing leadership skills in teachers and department heads by providing them with opportunities to attend seminars and conferences; building collegiality among teachers, and networks between teachers and other mathematics professionals; and enabling teachers to infuse into their instruction a sense of the imbeddedness of mathematics in the real world.

The collaborative's Steering Committee and Teacher Council provide input to the project director. The Steering Committee is comprised of the executive director and a Board member of the San Francisco Education Fund; representatives from the Exploratorium, San Francisco State University, the University of San Francisco, City College of San Francisco, and the San Francisco Unified School District; the collaborative's Development and Community Outreach director; the current and the two former collaborative project directors; a representative of the San Francisco Mathematics Teachers Association; and the chairperson of the collaborative's Teacher Council. The committee meets monthly to develop and implement policy, to monitor and evaluate activities, and to plan future events. The Teacher Council is comprised of seven teachers and a representative from the San Francisco Mathematics Teachers Association. The project director and the director of Development and Community Outreach serve as ex-officio members. The Teacher Council plays a central role in the design and implementation of the collaborative's activities.

During the 1987-88 school year, the San Francisco Mathematics Collaborative offered a wide variety of activities that enabled teachers to establish networks with their peers and with other professionals, and to increase their awareness of the developing world of mathematics and its applications. The 1987 Teacher Institute at the Exploratorium and a series of follow-up sessions exposed teachers to applications of mathematics in the physical sciences. A reception and a series of dinner lectures brought teachers together with distinguished professionals in the mathematical sciences, provided an opportunity for collegiality, and offered teachers valuable insights into current efforts to bridge the gap between mathematical theory and application in the worlds of commerce, industry and technology. Teachers were awarded mini-grants to support projects they had designed to enrich students' mathematics education. The collaborative also sponsored two discrete mathematics workshops and provided funds for teachers to attend local and national conferences and institutes offered by other organizations.

Twin Cities Urban Mathematics Collaborative

Director: Prof. Harvey B. Keynes
Teacher Coordinator: Ms. Sally Sloan
On-Site Observer: Ms. Gerry Sell
Funding Agent: School of Mathematics, University of Minnesota-Minneapolis
Date of Initial Funding: February 1, 1985

The Twin Cities Urban Mathematics Collaborative was one of the five original collaboratives established in 1985. The collaborative, which serves approximately 260 junior and senior high school mathematics teachers in public, private, and parochial schools within the boundaries of the Minneapolis and St. Paul school districts, is administered through the School of Mathematics at the University of Minnesota.

Since its inception, the collaborative has directed its efforts at helping teachers to exercise more control over their professional lives; at providing professional and educational opportunities to teachers; at expanding the involvement of business and industry; at integrating its efforts with those of other mathematics education organizations; and at increasing its visibility, especially within the school district.

The collaborative's director receives input from a Steering Committee and a Teacher Advisory Committee. The Steering Committee, which oversees collaborative activities, is comprised of sixteen members, including teachers, mathematics supervisors, representatives from local industries, area universities and colleges, and the Science Museum of Minnesota. The Teacher Advisory Committee is composed of the teacher coordinator, five teachers who participated in one of the collaborative-sponsored Summer Institutes, the collaborative director, and Dr. Wayne Roberts, a member of the Steering Committee and a professor of mathematics at Macalester College. It is the committee's role to serve as an advocate for teachers' ideas and to act as a sounding board for the Steering Committee. Two teachers from the Teacher Advisory Committee also serve on the Steering Committee. Each public and private secondary school has a building representative who serves as the collaborative's emissary to the teachers in his or her school. The Building Representative group is made up of thirty-four teachers, the Teacher Coordinator and the project historian. A Permanence Task Force was established in December, 1987, to write the guidelines for the proposal to the Ford Foundation for an "exit grant" to enable TCUMC to become permanent. The task force is composed of seven members, one ex-officio member and a facilitator.

During the 1987-88 school year, the Twin Cities Urban Mathematics Collaborative sponsored a wide variety of activities for junior and senior high school mathematics teachers. These included the 1987 Summer Institute, which focused on a problem-solving approach to number theory; an Academic Year Seminar Series in conjunction with the NSF Teacher Renewal Project; a series of four dinner lectures sponsored by the Twin Cities Mathematics Society (TCMS); a tour of Norwest Bank; a one-week Summer Institute on the NCSSM pre-calculus curriculum materials; and a one-week Woodrow Wilson Summer Institute on statistics and quantitative literacy. The collaborative also funded teachers to attend a variety of regional and national conferences and workshops. In addition, five issues of the collaborative newsletter, an important networking component of the project, were published and distributed. The newsletter is co-edited by the teacher coordinator and the on-site observer.

III. THE UMC NETWORK

The Urban Mathematics Collaborative project is more than eleven isolated sites discovering what works best in their local situations to enhance the professional lives of teachers. As an explicit element of the Ford Foundation's vision of change, the eleven collaboratives are connected by a shared support system to which they can turn for services, ideas, help, and direction. This support system is comprised of the program officer from the Ford Foundation and staff from the Education Development Center, Inc. (EDC), in Newton, Massachusetts and from the Documentation Project at the University of Wisconsin-Madison. The support system they provide directly affects and helps to define the total project and has created an overriding cohesiveness that links all of the individual sites.

The UMC project is a national network recognized by the collaborative projects' administrations, as well as by the teachers within the individual sites, as a key contributor to the development of collaboration on a variety of levels. An annual UMC meeting is held each October at one of the eleven sites, and the directors, coordinators, and district mathematics supervisors each meet on separate occasions during the year. All but two sites are linked by electronic mail, and a UMC project newsletter, *umc <ANGLES>*, is published and distributed to all of the sites. UMC project staff are on call to help the collaboratives as needed, such as occasions in which the program officer has been invited to visit with top district administrators, chief executive officers, and prestigious community boards to help increase a collaborative's visibility and local support. In addition, EDC has invited collaborative teachers to special sessions at the NCTM annual meetings, and has provided encouragement and financial support to enable teachers to attend a variety of conferences, workshops, and UMC activities. As a result, some teachers at each site have become acquainted with their peers at other sites and the foundations of a broad-based collegial network have been established. As the impact and value of the UMC project is considered, it is important that analysis be founded on a firm understanding of the organizational context in which it operates; evaluation must consider not only the contributions the project makes to each of the eleven sites, but its own progress and development as well.

Ford Foundation

Through its program officer and policies, the Ford Foundation has had an important impact on the UMC project. Initially, the Foundation's proposal guidelines set limits on what the projects could and could not do. There was, however, sufficient flexibility in these guidelines to allow each site to pursue its own vision and to establish its own goals. As the collaboratives developed, the Foundation was receptive to changes or adjustments to the guidelines, in response to situations arising at the various sites. For example, some collaboratives wanted to include science teachers, while others planned to open their activities to participation by junior high and middle school mathematics teachers.

At the end of their second year, each of the collaboratives was required to submit an interim report of activities. The four newest collaboratives submitted these reports late in 1987-88, just as the seven older collaboratives were submitting their permanence proposals. The program officer, Dr. Barbara Scott Nelson, sought input from the site directors as the reporting process was formalized, and she distributed directions to the collaboratives well in advance of the deadline. This sensitivity to the administrative needs of the sites and the flexibility with which the collaboratives are allowed to respond to local conditions characterize the general framework under which the projects operate.

Three times each year, Dr. Nelson convenes a meeting of staff from EDC and the Documentation Project to discuss issues and developments relevant to each collaborative. At these meetings, participants identify areas of concern and outline plans of action. In addition, these meetings provide an opportunity for the Technical Assistance Project, the Outreach Project and the Documentation Project to keep one another apprised of their ongoing activities and to plan together.

The program officer provides both support and guidance to the collaborative projects. On occasion, Dr. Nelson has raised topics of concern to a collaborative director or project coordinator, either by letter or in direct conversation. Issues that have merited such attention include project outreach to all targeted teachers and administrative structures most likely to support and foster permanence. In addition, the program officer has played a role in generating and maintaining local support for the collaborative's efforts and programs.

From the outset, it has been the expectation of both the Ford Foundation and the projects themselves that, in time, the individual collaboratives would become self-sustaining. During 1987-88, seven collaboratives wrote proposals outlining their approach to permanence and independence. In addition, beginning in June, 1987, EDC assumed many aspects of the project monitoring function formerly covered by Dr. Nelson. EDC is now responsible for overseeing the project as a whole, as well as for addressing day-to-day issues of project management. Dr. Nelson, however, will continue to monitor and allocate all project funds and play an instrumental role in the UMC public relations efforts.

Technical Assistance Project (TAP)

Beyond finances, the most important source of support for the collaboratives is the Technical Assistance Project (TAP), under the direction of Dr. Mark Driscoll of the Education Development Center, Inc. The TAP staff includes Grace Kelemanik, research assistant; Sheila Flood, administrative assistant; Anita Kron, administrative assistant; and Kristin Bjork, technical consultant. In addition to serving as a general resource to the projects, the TAP schedules and sponsors meetings for groups of collaborative administrators; manages the Common Ground electronic network; helps to identify and fund guest speakers at various collaborative events; assists individual collaboratives in organizing conferences; helps fund teachers' attendance at national meetings, such as the Exeter and NCSSM conferences; helps defray the cost of Woodrow Wilson One-Week Summer Institutes; and generally serves as a resource to the collaboratives.

During the summer of 1987, EDC submitted a proposal to the Ford Foundation to continue the operations of the Technical Assistance Project and to establish the Outreach Project. The proposal identified four categories of assistance that EDC could provide to the collaboratives: substance, governance, communication, and self-sufficiency. EDC's efforts have been directed toward bringing UMC teachers to the forefront of their profession in terms of their substantive knowledge about curricular reform, technology in the classroom, issues of equity, cognitive research and new instructional methods. The Center's focus on project governance has facilitated the collaboratives' smooth and productive development, and its emphasis on communication and networking has moved the sites toward a sense of their own uniqueness and a recognition of their own internal resources. Finally, EDC has fostered in the collaboratives a commitment to self-sufficiency and a willingness to identify and pursue resources available outside the UMC network.

In providing service and support to the collaboratives, the Technical Assistance Project staff is in frequent communication with the collaboratives--discussing issues, helping to solve problems, advising, identifying resources, and thinking through courses of action. Much of this ongoing consultation and feedback has occurred as part of TAP's efforts to serve as a resource as the collaboratives lay the groundwork for their own success. In addition, TAP sponsored or promoted a variety of activities during 1987-88.

Urban Mathematics Collaborative Annual Meeting

The third UMC Annual Meeting was held October 22-24, 1987, in New Orleans. More than seventy collaborative participants were in attendance, including the directors, coordinators, district mathematics supervisors, and on-site observer from each site; staff from each of the three support groups; and invited guests. The keynote address was delivered by Professor Linda McNeil of Rice University, who spoke about professional autonomy for teachers and about the need to get teachers' "best knowledge" into the classroom. Following the presentation, participants separated into four discussion groups, each of which was assigned a topic derived from the keynote address: teacher culture, psychological issues, realities of school administration, and realities of mathematics teaching. The remainder of the day's schedule included a report by the Documentation Project and meetings of the collaborative administrators. On the second day, a panel of three collaborative participants discussed the mathematics curriculum, followed by breakout sessions led by each of the three. Panel members included Mr. Richard Klein of the Nordson Corporation, a participant in the Cleveland collaborative; Professor Anthony Ralston of SUNY-Buffalo, a member of the Mathematics Sciences Education Board and the chair of its Frameworks committee; and Professor Thomas Romberg of the University of Wisconsin-Madison, the chair of the NCTM *Standards* Commission. The afternoon also featured a discussion on mathematics and equity by panel members Professor Uri Treisman of the University of California-Berkeley, whose work focuses on enhancing mathematics education for minorities and who had worked with three of the collaboratives; and Dr. Shirley Malcom of the American Association for the Advancement of Science, whose work centers on generating parent and community involvement in promoting better mathematics education for minorities. Following this session, participants adjourned to have dinner together. The final day of the meeting began with a discussion of the newly established Outreach Project and a report from the Technical Assistance Project, and concluded with breakout sessions in which each of four discussion groups considered a practical issue facing the collaboratives: development of success measures, permanence, sharing resources, and the Los Angeles training model.

Some additional events were associated with the annual meeting. Participants were asked to respond to a questionnaire on the use of Common Ground. The UMC mathematics specialists met October 21 to discuss the NCTM *Curriculum and Evaluation Standards*, the Documentation Project's report on professionalism, and issues facing each of the sites. Following the annual meeting, participants received transcripts from all of the main sessions and reports from the breakout sessions.

UMC Directors Meeting

The meeting of the UMC directors was held in San Diego on February 25, 1988. Twenty people attended, including seven site directors; the co-directors from San Diego; the executive director and +PLUS+ director from Los Angeles; the executive director and director of development and community outreach from San Francisco; the director of the Mathematics and Science Education Center and the collaborative director from St. Louis; Dr. Barbara Scott Nelson; three representatives of EDC; and a staff member of the Documentation Project. The meeting, scheduled to provide the directors with an opportunity to interact and share ideas, was largely devoted to open discussion. Issues raised included the meaning of collaboration; the derivation of leadership, equity and excellence; teachers' views about the value of national colleagues; board or agency requests for evidence of collaborative successes; and the potential fund-raising problem for collaboratives that forego a distinctive identity as a result of their successful networking with other community agencies. The group also designated Philadelphia as the site of the annual meeting in October, 1988, and identified members of a planning committee to work with EDC. Committee members included Harvey Keynes, Barbara Patterson, Alma Marosz, Sue Stetzer, and Nancy Gates.

UMC Activities at the NCTM Annual Meeting

The Technical Assistance Project conducted a number of activities at the NCTM Annual Meeting in Chicago, April 6-8, 1988. On Wednesday morning, the project sponsored a breakfast meeting for the UMC mathematics specialists. That evening, TAP hosted a wine-and-hors d'oeuvres reception for UMC participants. Nearly all of the collaboratives were represented, although a few representatives had problems flying into Chicago because of heavy fog. At a Thursday morning session of the NCTM meeting, Mark Driscoll presented an overview of the UMC project to about seventy-five people, including several collaborative members. Driscoll's presentation covered the topics of mathematics, collaboration, and professional empowerment, and concluded with an announcement of the Durham conference on mathematics reform and teacher professionalism to be held in June.

The UMC's activities on Thursday concluded with a meeting from 5 to 7 pm on the top floor of the Executive House at which approximately fifty teachers discussed the NCTM *Curriculum and Evaluation Standards*. Each small group of eight to ten teachers was assigned a specific *Standard* from the 9-12 *Standards*, and each group's discussion was directed by a leader and documented by a recorder, both of whom had been appointed prior to the meeting by the EDC staff. Teachers were asked to brainstorm about ways to implement their particular *Standard*, to list potential barriers, and to make suggestions as to how those barriers could be removed or overcome. At the close of the session, each recorder presented his or her group's report. The overall findings from the reports were summarized by Toby Bornstein.

Friday's agenda started with a coordinators' breakfast meeting sponsored by EDC. Nancy Gates, coordinator of the Memphis collaborative, was responsible for setting the agenda. Seven UMC coordinators or their representatives, four members of the EDC staff, and two from the Documentation Project attended. The initial discussion centered on the most efficient way to collect demographic and contextual information from the sites. The coordinators suggested that the Documentation Project send the district superintendents a context questionnaire soliciting pertinent data. This discussion was followed by the coordinators' presentations about the activities and efforts underway at each site and a general discussion about the characteristics of successful activities, possible changes in the school system, and steps toward permanence. The coordinators reported that the meeting was very valuable and should be held annually.

The UMC's final event at the NCTM conference, a program on the Geometric Supposer, was scheduled from 5 to 7 pm Friday on the top floor of the Executive House. Nearly 100 people representing the various collaboratives attended. Three UMC teachers planned and made presentations, with the assistance of Sue Stetzer, coordinator of the Philadelphia collaborative. Paul Hampel, a teacher from Philadelphia, offered his impressions of the NCTM *Standards* and his views about teaching in the 21st century, and then provided some examples of conjectures he uses with students working on the Geometric Supposer. Velma Hodges, a teacher from Memphis, described her experiences with the Supposer in her class of twenty ninth-grade students and discussed the Supposer's value as a tool with which to implement the NCTM *Standards*. Finally, Chip Healy, a teacher from the Los Angeles area, described his students' efforts to develop their own geometry textbook, using the Geometric Supposer as an important resource. Prior to the textbook project, geometry students had traditionally experienced nearly a 50 percent failure rate. The process of developing their own text helped students to increase their knowledge and enhance their interest in geometry, thereby improving their performance. Toby Bornstein, the director of the +PLUS+ program, closed the session by asking teachers to reflect on the conference sessions and to share their views and perceptions about what they had learned.

National Conference on Mathematics Reform and Teacher Professionalism

One major effort of the Technical Assistance Project during 1987-88 involved its cooperation with the Durham Mathematics Council and the North Carolina School for Science and Mathematics to plan and present a conference on teacher professionalism and mathematics education reform. EDC played an important role in helping to define the program and identify the speakers. In response to a request by the EDC, for example, MSEB provided advice in designing the conference and three of its members participated as panelists. In addition, EDC paid the expenses of two teachers from each of the eleven collaboratives to attend the conference.

The two-day conference, which was held June 24-25, 1988, in Durham, was designed to inform and guide the broader mathematics community in its efforts to improve mathematics at the pre-college level. The purpose of the event, which included presentations and discussions led by distinguished mathematicians and educators, was: (1) to review the recommendations for change by the National Council of Teachers of Mathematics and the Mathematical Sciences Education Board (MSEB); (2) to explore the role of teachers as designers, critics, and consumers of a changing curriculum; (3) to consider local alliances as a vehicle for mathematics reform; and (4) to explore approaches to enriching the mathematics curriculum for all students.

The conference agenda included two panel discussions, one focusing on the need for change in mathematics education and the second on local strategies for bringing about change. Following each panel presentation, conference participants broke into small groups to discuss their concerns and to share their ideas and strategies for affecting change. Asked what teachers could do to become involved in curriculum reform, one teacher responded, "I'm going to find out who's in charge of curriculum to see when the next revision is scheduled and how to get involved." During the course of another small-group discussion on two key components of professionalism--defined by panelists as sharing and risk-taking--an administrator from a small school district commented, "I'm going to meet with our teachers to see what their needs are."

In addition to these panel presentations and small-group discussions, the conference offered a series of workshop presentations on various programs for change happening across the country. Programs included the Woodrow Wilson Institutes, Challenge of the Unknown, and National Science Foundation program opportunities.

The Durham conference marked EDC's first cooperative effort with one of the collaborative sites to present a national conference. Considerable time and effort were expended in identifying and contacting potential speakers and in acquiring their commitment to participate. In addition, EDC's overtures to MSEB were met with some success, thereby establishing some linkages between the collaboratives and those in the broader mathematics education community. Finally, the conference provided several collaborative teachers the opportunity to assume leadership roles and to serve as resources to their colleagues from around the nation. In these roles, teachers provided clear examples of the impact of collaboration. After describing a series of activities in which he was engaged, a San Francisco teacher commented, "I wouldn't have gotten involved if it hadn't been for the collaborative." The energy of collaborative teachers was apparent to others at the conference. A newly hired collaborative coordinator commented, "I'm struck by the enthusiasm toward teaching and commitment to their students that all the teachers I've talked to have experienced." As a result of the conference, EDC and TAP were able to expand their role as resources through which teachers could enhance their leadership skills, their professionalism, and their contributions to curricular reform.

Communication Network

One of the Technical Assistance Project's major contributions to the collaboratives has been its efforts to facilitate communication among the individual sites. In particular, the Common Ground electronic network was expanded during 1987-88 to include a variety of forums designed to meet the needs of the collaboratives at their various stages of development. The Geometry Forum, for example, links Los Angeles and Philadelphia teachers with Geometric Supposer experts and EDC staff. A second forum, focusing on issues of project permanence, is monitored by Toby Bornstein of the Los Angeles collaborative, and a third forum discusses appropriate outcomes. In general, forum dialogues are triggered by questions posed by the monitors; typically, several questions are offered before one catches participants' interest. The Geometry Forum, for example, took several months to become well established, but by the spring of 1988, there were periods when there would be one or two new messages each day. It has become clear that the role of the forum monitor is crucial to generating interaction; where there has been no monitor, such as with the outcomes forum, little activity has occurred. A questionnaire on the use of Common Ground was distributed to participants at the UMC annual meeting in New Orleans. An observation made repeatedly was that the network's success depends in large part on having all of the collaboratives on-line, and in having a group of users at each site who would log on regularly. Respondents indicated that the network's value lies in its ability to foster informal and convenient communication among sites.

Site Consultation

The TAP's contributions to the collaborative include individual consultation to each of the eleven collaboratives. During 1987-88, Dr. Driscoll visited each site, typically working with an advisory committee or the collaborative staff. Dr. Driscoll's efforts were particularly important during the past year in helping some of the seven older collaboratives think through their permanence plans. For example, TAP helped the Philadelphia collaborative reevaluate and modify its governance structure. Staff from EDC also reviewed the permanence proposals for several collaboratives that requested such evaluations; this feedback took the form of written reactions, communications with the collaborative staff, and meetings with permanence committees. As a result of such interactions with sites, EDC identified three issues that it intends to monitor in the future: the presence of business people on advisory committees, the role of teachers in governance, and the type of administrative structure that will provide the vision, direction, and leadership for each collaborative in the future.

Program Assistance

In addition to drawing on the expertise of EDC staff, the Technical Assistance Project helped pay the cost of bringing speakers to make presentations to some of the collaboratives. EDC helped to defray the costs of bringing Professor James Schultz of Ohio State University to talk to Philadelphia teachers on the NCTM *Curriculum and Evaluation Standards*, and Professor Christian Hirsch of Western Michigan University to talk about the *Standards* to teachers at a New Orleans Mathematics Collaborative symposium. In addition, EDC commissioned Professor Arthur Powell of Rutgers University to write a paper presenting his views on the impact that research in cognitive psychology and writing can have on instructional models for equity.

Finally, Dr. Driscoll moderated a discussion on North Carolina's teacher Career Ladder Program sponsored by the Durham Mathematics Council. The discussion was designed to present DMC teachers with more information about the Career Ladder Program, as well as the North Carolina Effectiveness Teacher Training Program, and to provide teachers with an opportunity to voice their opinions on the Career Ladder Program before it was adopted by the state. This activity was planned in light of a perceived need to help collaboratives respond to district or state programs that dictate requirements and affect teachers' professional lives. The Durham event was designed to inform teachers and to generate interest in addressing these issues. EDC's participation was viewed as an experimental model through which collaboratives could learn to grapple with state educational policies. As it turned out, the panel discussion resulted in an open exchange of ideas about teacher evaluation between Durham teachers and the panel members.

Support of Professional Experiences

EDC has sponsored the attendance of collaborative teachers at a variety of local and national conferences. Examples include EDC's sponsorship of the three teachers who discussed the Geometric Supposer at the NCTM Annual Meeting in Chicago; its funding of two teachers from each collaborative, plus the speakers, to attend the 1988 Durham conference; and its funding of two teachers from each collaborative to attend a computer conference in Exeter, New Hampshire, in July, 1987.

In addition to this financial support of teachers' attendance at professional meetings, EDC facilitated the efforts of four collaboratives that hosted Woodrow Wilson One-Week Summer Institutes on geometry during the summer of 1988. EDC helped to negotiate arrangements between the Woodrow Wilson National Fellowship Foundation and the collaboratives in Memphis, Los Angeles, Pittsburgh, and New Orleans. The Ford Foundation worked through EDC to establish a closer link between the UMC project and the Woodrow Wilson National Fellowship. Thus the $40,000 cost of the four institutes, which was covered by EDC, came from funds targeted by the Ford Foundation for the specific purpose of developing a stronger association between the collaboratives and the Woodrow Wilson National Fellowship Foundation. A total of approximately eighty teachers attended the four institutes.

The Technical Assistance Project also distributes information about regional and national conferences and institutes to make the collaboratives more aware of the variety of opportunities available for the professional development of teachers. This information is often disseminated through a Common Ground forum as well as through mailings to the project directors and coordinators.

Outreach Project

The 1987-88 school year brought a new project into the UMC enterprise. Initially called the Information Project, the program was later renamed the Outreach Project. Operated by EDC under the direction of a four-member staff, the Outreach Project evolved out of conversations between the Ford Foundation program officer and EDC about the importance of sharing the lessons being learned through the UMC project and how other communities can create their own collaboratives. Mr. Brian Lord was hired in September to be the project director. Having served as Assistant Director to Stanford University's Institute for Research on Educational Finance and Governance, Mr. Lord brings to the position a strong background in education policy. In April, 1988, Ms. Janet Daisley joined the project as Associate Project Director. Ms. Daisley has a master's degree in public and international affairs from the University of Pittsburgh and came to the project from the offices of a Massachusetts state senator and from the staff of the Special Legislative Committee on the Conditions of Teaching. Until December, 1987, Melissa Fox split her time as Administrative Assistant between the Outreach and Technical Assistance projects. In December, she was appointed to work as a full-time research assistant for Outreach. To help the Outreach component identify its mission and its position within the UMC project, a planning group met in fall, 1987, to clarify the project's roles and activities. This advisory group included EDC President Janet Whitla, EDC Vice-President Myles Gordon, Mark Driscoll, Brian Lord, Barbara Scott Nelson, and Tom Romberg. Advice also was sought from the collaborative leadership during visits Mr. Lord made to six of the sites during the fall of 1987.

The Outreach Project has defined as its major goal "to capture the UMC experience, in all of its richness and complexity, and to distill and to communicate that experience to the appropriate audiences." A three-part strategy has been adopted:

1. to support the work of the existing collaboratives;
2. to enable other communities to replicate or adapt important features of the UMC model; and
3. to inform and influence the education policymaking community in its efforts to promote teacher professionalism and locally based educational change.

Support of Existing Collaboratives

The Outreach Project, in conjunction with the Technical Assistance Project, has worked to support the efforts and development of the existing eleven collaboratives. This assistance has included providing information and support to the individual sites and fostering communication among the collaboratives on the issues of permanence, evaluation, and fostering a national identity. On the issues of permanence, the staff of the Outreach Project produced an article for the newsletter *umc <ANGLES>* on the Twin Cities Urban Mathematics Collaborative's permanence planning process and helped to establish the Common Ground forum on permanence. The Outreach Project, in cooperation with the Technical Assistance Project, is developing a framework for identifying appropriate outcomes in the evaluation of the collaboratives. This focus will continue to be important.

To help the collaboratives establish a presence on local, state, and national levels, the Outreach Project developed a videotape about the UMC project that was released in October, 1988. The actual shooting of the videotape began at the directors' meeting in San Diego, where each collaborative director was interviewed on tape. The shooting continued at the NCTM annual meeting, where collaborative teachers were taped as they interacted at the UMC work sessions. A Los Angeles +PLUS+ workshop, a Cleveland corporation site visit, and a San Francisco Exploratorium trip also were included in the videotape. Entitled *Leadership and Learning*, the videotape will be available for the collaboratives to use in their local fund-raising efforts to help communicate the importance of collaboration and to articulate the clear link between the local collaborative and the national UMC project. It will also serve as a valuable tool for disseminating general information about the collaborative.

The Outreach Project also assists the collaboratives in their efforts to gain visibility in their communities. For example, the project sent a press release to the Durham media concerning the National Conference on Mathematics Reform and Teacher Professionalism. As a result, three articles about the conference appeared in local newspapers.

During 1987-88, responsibility for publishing the *umc <ANGLES>* newsletter was transferred from the Technical Assistance Project to the Outreach Project. Two issues of the newsletter were prepared during the year and distributed to the staff of the eleven collaboratives, the staff of the supporting groups, and others who have expressed an interest in the UMC project. Articles in the October, 1987, issue announced the formation of the Outreach Project and its connection to the existing Technical Assistance Project. Other articles included one by Drs. Diane Briars and Leslie Salmon-Cox on the Pittsburgh collaborative; an article by Grace Kelemanik on technology in the urban setting; and a report on the September alliances conference sponsored by the Triangle Coalition for Science and Technology Education. In addition, the newsletter listed dates and locations of NCTM regional and national meetings, and of other professional meetings. The March, 1988, issue included a report on the UMC annual meeting in New Orleans; an article by Mr. Lord on the Twin Cities collaborative permanence process; an article by Ms. Kelemanik on the Geometric Supposer network; an article by Mr. Chip Healy, a teacher from El Monte, California, on his geometry class that was developing its own textbook; highlights from each of the eleven collaboratives; an article by Mr. Robert Seitz, who is a teacher and the on-site observer from Cleveland, on some of his experiences in teaching; an article by Ms. Melissa Fox that reported on the responses to the Common Ground questionnaire; and announcements of the schedule of the UMC working sessions at the NCTM annual meeting and of the Durham conference on mathematics reform and teacher professionalism. The March issue also marked the appearance of two new columns that will become permanent features of the newsletter: "One Teacher's Answer" and "Collaborative Highlights."

Replication

An important goal of the Outreach Project is to facilitate the replication and adaptation of the collaborative models being developed by the UMC project. In addressing this priority, the Outreach Project has sent informational mailings, held telephone conversations with individuals who have inquired about the UMC project and who have expressed interest in developing a collaborative, and made on-site presentations to interested groups. Such interest has been expressed by people in several cities, including Indianapolis, Seattle, Hartford, and Dayton. To facilitate this dissemination of information, the Outreach Project initiated two major projects: the UMC videotape, *Leadership and Learning*, and an information handbook and resource packet. The videotape will be ready by fall, 1988. The handbook and resource packet, which are being designed to be used in conjunction with replication tutorials, will be available in spring, 1989.

Networking

A third major focus of the Outreach Project in 1987-88 was the development of national networks that would help to create a favorable environment in which collaboratives could be established. Outreach activities toward this end included developing formal and informal ties with education policy groups such as the National Conference of State Legislatures, the National Governors' Association, the College Board, the National Board for Professional Teaching Standards, the Triangle Coalition, the Education Commission of the States, the Holmes Group, the Institute for Educational Leadership, the Council of Great City Schools, the National Council of Teachers of Mathematics, the Mathematical Sciences Education Board, and the American Mathematics Project. Outreach Project staff have made presentations at conferences, authored papers, and developed jointly sponsored activities in establishing ties to these groups.

The Outreach Project's efforts to build an alliance between the UMC project and the Teacher Networks Group, which is an organization of funders, builders, and operators of teacher network projects, is a key aspect of its networking approach. Network members include representatives of the Ford Foundation, the Carnegie Corporation of New York, the Rockefeller Foundation, the National Science Foundation, and the Hitachi Foundation, as well as the directors and managers of the network projects they fund. The objectives of the Teacher Network Group are to address policy issues related to school structure and teachers' professional development; to address strategic issues related to technical assistance, evaluation, and project permanence; and to address operational issues related to the formation of alliances across sectors and to the provision of state-of-the-art information to teachers. Several UMC project directors and members of the EDC staff attended a meeting of the Teacher Networks Group in June, 1988. A second meeting is scheduled for December, 1988.

Documentation Project

The Documentation Project continued to collect and synthesize data and information on the UMC project during 1987-88. Site data included monthly reports and teacher interviews from the on-site observers, a teacher background questionnaire distributed to the "core" teachers at each site, and site visits by Documentation Project staff. An additional form was added to the Monthly Reports at the beginning of the school year to encourage the on-site observers to classify information and make personal observations on the topics of project management, collaboration, professionalism, and mathematics focus. In addition to completing the Monthly Reports, the on-site observers were asked to interview five teachers in April and an additional five in May, and to record their responses to questions regarding the impact of the collaborative on their teaching; their interaction with those in business and higher education, as well as their colleagues; their knowledge of mathematics reform; and any other impacts the collaborative may have had on their professional lives. The on-site observers met as a group twice during the year, once at the UMC annual meeting in New Orleans and again at the NCTM annual meeting in Chicago. At these times, the procedures for collecting data, the format of the monthly reports, and other topics were discussed.

As information was collected and analyzed during the year, some of the sites were asked to administer the Teacher Background Questionnaire to additional teachers to increase the total number of participants over 1986-87 levels. As a result, responses were received from more than 400 teachers. Information from these questionnaires, which was entered into a data base for analysis during the summer of 1988, served as the foundation of a working paper. Questionnaire data are being compared and contrasted to data collected in a 1985-86 national survey (Weiss, 1987). Data analyses from the 1985-86 and 1986-87 professionalism questionnaires were presented in a draft report during 1986-87; the final report was prepared for the 1988 UMC annual meeting. A context questionnaire requesting demographic information on the district, its mathematics teachers, and its mathematics students was sent in June to each superintendent of a district associated with a collaborative. This questionnaire was designed to document some of the conditions under which the collaboratives operate.

Twenty-seven site visits were conducted during 1987-88 by members of the Documentation Project. Site visits typically involved classroom observations, conversations with teachers, and interviews with district mathematics specialists and district administrators. An effort was made to schedule site visits to coincide with collaborative activities so that the documenter could attend a special project event. One site visit to each collaborative was devoted to reviewing a draft of the site's annual report with the collaborative director or coordinator as a means of validating the information included in the report. In addition to their site visits, documenters attended special functions related to the UMC project, including the UMC work sessions at the NCTM annual meeting, the Durham conferences, and a variety of meetings of the directors, coordinators, and mathematics specialists. After each site visit and most activities, the documenters prepare notes that describe the activity and his or her reactions to it.

Each year, a major effort is expended in writing the UMC project's annual report to the Ford Foundation. Preparation for the 1986-87 UMC annual report began in July, 1987, and continued through the printing of the report in February, 1988. The process included synthesizing the information from all of the sources that has been entered into the data base, writing the summary reports, sharing these reports with the collaborative leaders, and modifying them in response to the site's perceptions and input. After extensive revision and, in some cases, repeated interactions with the collaboratives, a final version of the report was prepared and then shared with the sites. Concurrently, the substantive evaluative part of the report is written, reviewed by all of the members of the Documentation Staff, and then finalized. Nearly 200 copies of the report are printed, and five copies are sent to each collaborative.

Case Study Component

A case study component of the Documentation Project was initiated in December, 1987, under the direction of Professor Thomas Popkewitz of the University of Wisconsin-

Madison. This project will conduct case studies on one or two teachers at each of the eleven collaboratives, six during 1987-88 and five during 1988-89. The completed set of case studies, which will be presented in a final report in 1990, will highlight a variety of teachers, all of whose professional lives have been affected by the UMC project. The extent to which the individual teachers have availed themselves of the opportunities and programs offered by the collaborative has varied both by individual and by site, but overall, most case study subjects were active participants in their local projects.

During the winter of 1987-88, Professor Popkewitz, assisted by Project Assistant Sigurjon Myrdal, identified an on-site ethnographer for each of the first six collaboratives to be studied: Pittsburgh, Cleveland, Twin Cities, St. Louis, Los Angeles, and San Francisco. Dr. Popkewitz and Mr. Myrdal visited each of the six sites to meet with the ethnographer and then with the collaborative administration. At these meetings, the Documentation Project staff explained the case study approach to the ethnographer and described how it fit into the overall documentation effort. This session was followed by a meeting with the collaborative staff, during which some of the teachers who would be potential candidates for the study were discussed.

The guidelines directing the researchers' selection of teachers for the case studies were flexible. Typically, the collaborative director and staff at each site provided the ethnographers with information about a core group of active teachers. Ethnographers then attended several collaborative events in order to gather background information and to meet the teachers. Based on these visits, and with the advice of the collaborative staff, the ethnographers identified one or two teachers to be the subjects of the case study reports. In gathering the information for the case studies, the ethnographer interviewed each teacher on several occasions and also observed the teachers extensively at school as well as in other professional contexts.

During the selection, research, and writing phases of the case studies, the ethnographers stayed in communication with the staff of the Documentation Project. In April, 1988, some of the ethnographers met at the American Educational Research Association's annual meeting in New Orleans and all of the ethnographers and case study component staff met for three days in Madison in May. In addition, some of the ethnographers were enrolled on Common Ground and thus were linked electronically with the Documentation Project staff.

Drafts of the first six case studies were completed in June, 1988. Two kinds of information are highlighted. The first describes the professional lives, interactions, and thoughts of these teachers as they work in the classroom, the relationship of their daily activities to their thinking about the collaborative, and the changes they perceive to have occurred as a result of their collaborative involvement. The case studies focus on the collaborative's effect on their everyday lives in schools and in classrooms, on their successes and frustrations, and on the tensions of the reform process itself. The second discusses the teachers' conceptions of mathematics and the teaching of mathematics, and the assumptions and implications that can be drawn from their pedagogical reasoning.

Initial impressions from the first six case studies indicated that the views of these teachers appear to be affected by a number of factors, including the characteristics of each collaborative, its focus, and the organization of the school district in which the collaborative operates. These considerations are particularly pertinent in regard to the teachers' interest in further knowledge about mathematics and the development of organizational skills related to teaching and professional matters outside the school. In light of these variations, the implications and meanings the teachers ascribe to professionalism and empowerment varied.

Reflections

The involvement of the Technical Assistance and Outreach projects, as well as of the Documentation Project, has wielded a noticeable impact on both the UMC project as a whole and on the eleven individual collaboratives. All three of the projects, in cooperation with the Ford Foundation, have served as accessible sources of support. The role of the Documentation Project is discussed in the Final Comments section of this report.

Both of the EDC projects--but particularly the Technical Assistance Project--have been as proactive as they have been reactive with regard to the needs of the collaboratives. The Technical Assistance Project, for example, assumed the task of soliciting the sites' reactions to the draft of the NCTM *Curriculum and Evaluation Standards*. This effort involved encouraging the individual collaboratives to discuss the *Standards* and culminated at the NCTM annual meeting in a work session in which teachers discussed implementation of the *Standards*. As a result of these overtures, nearly all of the collaboratives have initiated discussion related to the *Standards*. EDC, by bringing UMC teachers together at national meetings and through Common Ground, has generated communication among teachers across sites. Although the Common Ground Geometry forum was slow to develop, increased activity toward the end of the school year confirms the value teachers placed on being linked with other teachers through the electronic mail. It has become clear that EDC's willingness to test new kinds of communication networking has generated an approach with the potential of becoming a medium through which a wide variety of mathematics topics could be addressed by teachers across the nation. With the help and support of the Technical Assistance and Outreach projects, teacher leadership is developing. EDC's sponsorship and financial support of teachers' attendance at special institutes and its efforts to encourage collaborative teachers to present at national meetings have been instrumental in developing this professional self-assurance. Finally, EDC has helped UMC to position itself in the national arena of educational reform; toward this end, EDC has invited outside experts to participate in UMC annual meetings and has developed links with other reform projects through such organizations as the Teacher Network Group. Thus, EDC has provided project leadership, has served as a resource, and has worked to establish linkages between the UMC project and other national educational organizations. With EDC's assistance and support, the focus of the UMC project has expanded during the past year to encompass technology in the classroom, teaching of geometry, equity, and teacher leadership, as well as mathematics reform.

IV. OBSERVATIONS AND REFLECTIONS

It remains the underlying assumption of the Urban Mathematics Collaborative project that the collaboration between high school teachers and other mathematics-using professionals in higher education and in business will enhance the teaching and learning of mathematics in inner-city schools. This enhancement can be viewed as the anticipated outcome of the project's efforts to reduce the professional isolation of teachers; to boost professional enthusiasm; and to create an environment conducive to generating new ideas and approaches, discriminating among options, and encouraging resourcefulness. We describe *collaboration* as

> the processes and activities through which high school mathematics teachers develop and nurture working relationships with other mathematics-using professionals, including their colleagues within schools; within and across project sites; and within the broader mathematics community, including mathematicians in business and higher education. The depth of the collaboration can range from socializing to working together to achieve a common goal.

As the Urban Mathematics Collaborative project matures, so do our observations and reflections about its development and impact. The Summary Reports appended to the complete report offer a detailed description and a relatively explicit discussion of the context in which each collaborative has developed, the efforts each project is exerting as it works to meet its goals, and our general observations about each site; for purposes of clarity, these observations focus on four topics: Project Management, Collaboration, Professionalism and Mathematics Focus. These four headings represent some of the most complex and vital issues the individual sites are addressing, and our discussion is intended to shed some light on their progress, as well as on some of the difficulties they have encountered during the past year (between July, 1987, and June, 1988).

In contrast to the observations included in each of the Summary Reports, the comments offered here reflect a much broader, yet more singular focus. This section of the report offers insights and observations about the UMC project as a whole, as a national network of individual sites that has developed into an innovative and effective model for enhancing the mathematics education of youth in the nation's inner cities. Our discussion has been expanded to address not only the four issues listed above, but the topic of Context as well. As we began to evaluate the broader context in which the UMC project is operating, it became essential to consider the demographic and socioeconomic environment in which the teachers work. During 1987-88, a sustained effort by the

Documentation Project produced a demographic data bank consisting of statistical information about the sites, the communities in which they are located, and the teachers who are the focus of the project. The availability of these data makes it possible for the first time for us to discuss with some measure of certainty the populations of students, teachers and community members that define, to a great degree, the nature and dynamics of the collaboratives' challenges and problems.

The first five collaboratives were established in 1985. Since that time, the individual sites have progressed toward maturity and permanence, and the project's support system--which includes the Ford Foundation, the EDC Technical Assistance and Outreach Projects, and the University of Wisconsin Documentation Project--has developed in response to the collaboratives' needs. In addition, the Documentation Project has gathered and synthesized vast amounts of information from the sites and has presented that information in the form of three annual reports. Consequently, it is now appropriate to consider the impact the collaboratives are having on teachers and other mathematics professionals who have been associated with the projects.

Context

The urban context in which the eleven collaborative sites are located defines, in large part, their character, their function and their mission. More than 5 percent of the nation's population, for example, currently resides in the eleven cities served by a collaborative; population by site ranges from about 8.3 million residents in the Los Angeles metropolitan area to about 160,000 in the city and county of Durham.

Such population density within the boundaries of a school system inheres a variety of other social and economic conditions. In large part, school districts served by the collaboratives are characterized by relatively high drop-out rates as compared with national averages; relatively low achievement on standardized tests as compared with national norms; high numbers of students from families who receive AFDC benefits and who are eligible for government-funded lunch programs; high minority populations, with some sites reporting substantial percentages of students from more than five different racial groups and accompanying high rates of students who consider English a second language. In San Francisco, for example, one-third of the student population considers English a second language.

Similarly, many of the districts employ thousands of teachers and educate tens of thousands of students each year; for example, more than 1.3 million students attended schools in Los Angeles County during 1987-88 at a cost of billions of dollars to the local, state and federal governments. Within the context of such immense enrollments and enormous staffs, change and upheaval can become the norm rather than the exception. During the four-year span of the project, for example, administrative and educational crises have ranged from the disruptions caused by court-ordered desegregation, the threat of massive deficits, and the nagging worry of teachers' strikes to school closings, asbestos removal, and significant trends in enrollment toward greater numbers of students with special needs and problems. Additionally, many of the sites have undergone major shifts in leadership since 1985, with five of the eleven sites experiencing changes in superintendents and five undergoing changes in the position or role of the person responsible for the mathematics curriculum.

While it remains the case that the eleven sites share many--if not all--of these conditions, there is variation by locale. In San Francisco, for example, 92 percent of students are eligible for the federal lunch program; in New Orleans, about 75 percent of students are eligible; and in Cleveland, about 48 percent.

The Teachers

The efforts of the UMC project are directed toward enhancing the professional lives of more than 2,650 teachers of mathematics in eleven urban areas across the nation. This total includes all of the targeted high school mathematics teachers in each of the districts associated with the project, as well as some of the junior high and middle school mathematics teachers in at least six of the sites. The total number of teachers is an estimate rather than a specific number because, in at least one site, decisions about teaching assignments are made at the building level and the information is not collected centrally. Because of the high number of crossover teachers in some districts, it cannot be assumed that all, or even most, teachers assigned to mathematics classrooms are certified in the subject area. The majority of mathematic teachers in the targeted districts are certified and tenured, but there is some variance by site. In the Los Angeles Unified School District, for example, 85 percent of mathematics teachers are certified; in St. Louis, 82 percent are certified. In San Francisco, 40 percent of Algebra I and General Mathematics classes during 1987-88 were taught by crossover teachers, who were on record as not having mathematics majors or minors.

During the 1987-88 school year, the Documentation Project conducted a survey of the "core" teachers in each collaborative, with core defined as those teachers who had emerged from the general membership to provide leadership and who attended collaborative events regularly. Approximately 410 teachers, or about 16 percent of all targeted teachers, responded to the questionnaire. Of these, 65 percent were white, 25 percent were black, 5 percent were Asian/Pacific Islander, 3 percent were Hispanic and 2 percent were from other ethnic groups. This demographic distribution is distinctly different from a national sample determined by a survey of science and mathematics teachers in 1985-86 (Weiss, 1987). Nationally, 94 percent of mathematics teachers are white, 3 percent are black, 1 percent are Asian/Pacific Islander, and 1 percent are from some other ethnic/racial group.

The mean age of UMC core teachers is 41.5 years, as compared with a national mean age for teachers of grade 10-12 of 40.2 years. Similarly, 57 percent of core teachers were younger than 43, while 52 percent of the national sample was younger than 40. The number of years core teachers have been teaching mathematics ranged from 1 to more than 35, with a mean of 14.8 years, up slightly over the national sample of 14.2 years. Approximately 55 percent of UMC core teachers report that they hold post-baccalaureate degrees, a percentage that is identical to that of the national sample of teachers of grades 10-12. Of those reporting a college major, 54 percent of the UMC core teachers majored in mathematics or mathematics education, as compared with 60 percent of teachers (grades 7-12) nationwide. Although the difference is relatively slight, it does suggest that fewer teachers in the UMC core groups hold majors or minors in mathematics than would be expected in light of the national sample. With this exception, the collaboratives' most active participants are very similar to their colleagues throughout the nation in terms of levels of education, teaching experience and age.

The Students

During 1987-88, more than 323,000 students attended high schools in the eleven metropolitan areas served by the UMC project. Information about student enrollment in mathematics was unavailable from school districts in four of the eleven sites. But data from those seven sites that maintain such records suggest that 78 percent of high school students were enrolled in a mathematics class in 1987-88; the percentages ranged from 73 percent in San Francisco and Memphis to 84 percent in San Diego. Projections based on these figures indicate that collaborative teachers currently instruct approximately 250,000 students each year.

Project Management

The eleven collaboratives share an urban context: each experiences many of the same kinds of problems and challenges as a result of its affiliation with inner-city schools. They also share many common features and approaches as they strive to achieve the UMC project's vision. Despite these similarities, however, the management of each collaborative reflects a unique administrative style that has evolved in response to the particular needs and context of each of the collaborative sites. Several of these needs and contextual issues merit consideration: 1) the collaborative's relationship to its host agency, 2) the collaborative's administrative structure and its relationship to the operational style of the collaborative administrators, 3) the relationship that exists between the collaborative and the school district administration, and 4) the nature and level of resources in the community.

While it is clear that many of the projects' organizational structures have similar components, each collaborative is unique in many ways, so that no two sites can be considered identical. This individuality provides invaluable opportunities for the collaboratives to try different approaches, and for the Documentation Project to identify approaches and alternatives that have worked in one site for broader generalization to other sites, providing the appropriate conditions exist.

The Host Agency

In developing its proposal for initial funding, each collaborative site was required to establish a relationship with a local organization that would serve as the project's host agency. In six of the eleven sites, the host agency is a fund or a foundation; five are public education funds and one is a university foundation. In Durham and the Twin Cities, the host is a state agency, the North Carolina School for Science and Mathematics and the University of Minnesota. The Mathematics and Science Education Center in St. Louis and the Franklin Institute in Philadelphia are educational or content-specific institutions. And in Memphis, the Urban League is a special interest organization. The role and responsibilities of the host agencies vary from site to site. In most cases, the host agency has been instrumental in helping the collaborative establish a governance structure, in goal setting, and in establishing community contacts. Two key contributions of the host agencies have been in the areas of fund raising and community visibility and recognition.

Fund Raising

In many instances, the host agency has assumed fund-raising responsibilities for the collaborative, but this is not the case in all sites. In San Diego, for example, the host agency's role has been limited primarily to serving as a conduit for funds between the Ford Foundation and the collaborative. In Durham, Memphis and the Twin Cities, the host agency channels Ford Foundation money to the projects and helps to coordinate or provide administrative and clerical services, but it does not have major responsibility for the projects' fund-raising efforts. In contrast, the host agencies of the remaining seven collaboratives (Los Angeles, Pittsburgh, San Francisco, Philadelphia, St. Louis, New Orleans, and Cleveland) have assumed responsibility for fund raising, thereby freeing the projects' governing bodies to turn their attention from financial concerns to more substantive, goal-oriented issues.

Community Visibility and Recognition

In nearly all cases, the host agency has been a well-established organization with a great deal of community recognition and support. Through their affiliations with such organizations, the collaboratives have been able to tap into existing community networks and resources and have been able to present a public image of stability and permanence, right from the outset. One exception is St. Louis, where the collaborative and its host agency, the Mathematics and Science Education Center, were established concurrently and struggled through their initial stages of development simultaneously. Not surprisingly, the two organizations had some difficulties defining their own roles and their relationship to one another. It appears, therefore, that a stable, well-established host agency may be a factor in establishing a collaborative and ensuring that it has both public support and a defined niche within the existing network of community organizations and programs.

Administrative Structure

The organizational structures of the eleven collaboratives share many similarities. All of the collaboratives have a director, although under a variety of titles, including Executive Director, Director, and Project Coordinator. All but one of the projects has a coordinator and, one project, San Diego, has both co-directors and co-coordinators.

All but two of the collaboratives have a two-tier governing structure; one board primarily decides policy issues while the other focuses on programming and planning activities. The two exceptions, the San Diego and St. Louis collaboratives, each operate with only one governing board. Typically, the policymaking board includes representatives from all sectors--teachers, and representatives of business, higher education, and the school district administration. In only one collaborative, the policymaking board does not include representatives from business.

In general, the board that makes the decisions regarding collaborative programming is primarily comprised of teachers. In most sites it is called the Teachers' Council or Teachers' Advisory Board. In six of the sites, the teacher representatives are chosen so that there is one teacher from each of the targeted schools. In this context, teacher representatives also serve as liaisons to their schools, carrying information between the schools and the collaborative administration.

One of the factors that has affected the organizational structure of each collaborative is the delegation of responsibilities between the director and coordinator. In most collaboratives, the project director has assumed responsibility for interacting with the Ford Foundation, planning the budget, and, when necessary, fund raising. The coordinators typically are responsible for planning and implementing project activities, interacting with the school district and the teachers, and carrying out the day-to-day operations of the collaborative. It appears that the responsibility for public relations varies by collaborative, and is often shared. These are only generalities, however, and the specific delegation of responsibilities varies by collaborative.

Another factor that determines the organizational structure and management approach of each collaborative is the operating style of its administrators. In some cases, the director or coordinator works behind the scenes to facilitate the planning and implementation of collaborative programs; these administrators can be viewed as alliance builders who devote much of their time and energy to developing positive relationships with key teachers and school district administrators, as well as with those from business and higher education. In other collaboratives, the director or coordinator prefers to provide more visible leadership and to accomplish the project's goals by delegating responsibilities while retaining clear authority over most collaborative activities and decisions. Both styles have been effective, and they appear to result more from the personal preference of the administrators rather than from any explicit decision or design.

The strength and cohesion of their organizational structures have been tested at several sites in the past year as projects have addressed changes in key administrative personnel. In Cleveland, for example, where Project Director Paula C. Fay resigned in the fall of 1987, the collaborative managed to offer a full slate of activities and to develop a permanence proposal, despite the fact it operated with an interim director for three months and without a full-time coordinator for the last three months of the school year. In this case, the support of the Cleveland Education Fund Board and the viability of the collaborative's organizational structure made continued progress possible, even during a difficult transition time between directors. In New Orleans, where the collaborative director was promoted to the position of executive director of the Metropolitan Area Committee (MAC), the director and coordinator worked together to fill the administrative gaps until a new director could be appointed. These are but two examples of the ways in which sound management practices and stable organizational structures have allowed the collaboratives to function successfully despite transitions in leadership.

The Collaborative and Its School District(s)

The degree to which the school district administration is involved in the management of the collaborative varies from site to site. In most of the collaboratives, the district mathematics supervisor or supervisors have been very active in the organization and development of the collaborative; in these sites, the district administrations view the collaborative as a positive agent for change and a means by which the district's mathematics program can be enhanced and improved. A few of the collaboratives receive part of their locally matched funds from the school district. In several of the collaboratives, the superintendent of schools, or a representative, serves on the collaborative's policymaking board. In Pittsburgh, for example, the district math coordinator meets monthly with the collaborative leadership to plan and review collaborative activities and goals; similar interaction occurs in Cleveland. School districts have also shown support for their local collaborative in a variety of other ways, including permitting collaboratives to use school in-service days for programming, and providing release time and funding to enable teachers to attend activities and conferences supported by the collaborative. In a few sites, however, the involvement of the mathematics supervisor and other district personnel has been minimal, and a strong working relationship between the project and the school district has been slow to develop.

Community Resources

Finally, each collaborative's organizational structure and management approach have been determined, to an important degree, by the project's access to the business and higher education sectors; the community's traditions and past practices in terms of contributing to its schools; the expertise available or the type of business predominant in the area; and the resources and activities available to mathematics teachers from other programs or organizations.

Examples of these unique relationships and opportunities are as numerous as the collaboratives themselves. In San Francisco, the Exploratorium is an important community resource; rather than competing with its efforts, the collaborative has established a firm working relationship with the Exploratorium staff such that both programs benefit from their interaction and cooperation. In St. Louis, the collaborative has developed a popular and successful site-visit program, involving such local businesses as the General American Life Insurance Co., and the McDonnel Douglas Corporation. The Cleveland collaborative has benefitted from a variety of local grants and awards. During 1987-88, for example, the Aetna Foundation awarded the collaborative a $23,000 grant to fund mathematics clubs in each of the city's intermediate and high schools, and the Ohio Board of Regents granted $41,000 to fund a joint effort by the collaborative, Baldwin-Wallace College and the Cleveland public schools to fund the Mathematics and Technology Human Resources Enrichment Project (MATHREP), which addresses the underpreparedness of mathematics teachers in the intermediate schools. In all cases, the collaboratives' organizational structures and approaches have developed in response to the local conditions unique to each site.

Impact of Administrative Structure

Thus, it is clear that each collaborative is unique in terms of its organization and management structures. In reflecting on these differences, and the ways they appear to impact on the projects' success in achieving their goals, three questions seem important: 1) How do the collaboratives' organizational structures relate to teacher empowerment? 2) How viable is the organizational structure in establishing and supporting networking between teachers and mathematics professionals from the other sectors? 3) What is the likelihood that any particular organizational structure will lead to a stable and permanent organization for the enhancement of the professional lives of teachers?

Teacher Empowerment

It appears that there is a relationship between the organizational structure of a collaborative and the degree to which it is successful in empowering teachers to make decisions and to provide direction for the project. All of the collaboratives involve teachers in the decision-making process to some degree, but there is some variation by site as to the extent of that involvement. In those collaboratives that have assigned major decision-making responsibility to a teacher's council or advisory board, such as the +PLUS+ departments in Los Angeles, a core group of very committed, involved teachers has emerged. The +PLUS+ approach is characterized by a firm focus on departmental team building, a powerful and influential teachers' council, ongoing teacher training to enhance participants' planning and leadership skills, and a collaborative board that provides general direction but does not usurp authority for day-to-day collaborative decisions. This management structure and leadership style have created a small group of very active teachers who have been empowered to make decisions, to guide the collaborative's development and to define its focus. In St. Louis, the twelve teachers who serve on the Collaborative Council have been very involved in making decisions for the collaborative. The majority of these teachers have served on the Council since its inception, and all of the collaborative's teacher leadership appears to come from this small group.

In other sites, collaborative leadership has been expanded to include greater numbers of teachers with somewhat less decision-making power. In the Twin Cities, a Building Representatives group comprised of teachers from each targeted school acts as a liaison between all district teachers and the collaborative, and as a conduit for information and teacher input. Because the group has retained much of its original membership, and because it has been relatively autonomous in its development and activities, the Building Representatives appear to be moving toward greater self-direction and empowerment. In Durham, the Steering Committee serves much the same purpose, and in Pittsburgh, the Department Chairs Group represents a similar approach at another level of authority.

In general, all of these groups have served to provide input, to ensure that the collaborative administration remains in close communication with the teachers it is attempting to serve, and to instill in teachers a sense that they can and should have some influence on the project, its activities and its focus. A question that remains is whether it is more effective to include a large number of teachers in the decision-making process, perhaps by rotating membership on the governing board, or to develop the leadership skills of a small group of teachers who serve on the board for an extended period.

Networking

The collaboratives seem to vary in terms of the degree to which their organizational structures support or encourage networking among teachers, and between teachers and mathematics professionals from other sectors. In all cases, the collaboratives have been structured to include committees or councils that bring teachers together to interact and to contribute their perspective and expertise. The membership of these committees often consists of the core group of teachers who are most committed to collaborative ideals and goals, and it is from these committees that project leadership has emerged.

With one exception, all of the collaboratives also have a board or a committee that links teachers with representatives of business, higher education, and the school district administration(s). While such a committee structure does work to support interaction among the various sectors, the collaboratives have discovered that meetings alone are insufficient to engender true networking. Similarly, many sites have concluded that they must move beyond simply providing information, such as a Speakers Directory, in hopes that the various sectors will initiate networking and interaction on their own. Instead, in order to foster more meaningful give-and-take and establish a shared sense of collegiality, some collaboratives have turned to a strategy involving task forces assigned to accomplish a specific task or goal. In New Orleans, for example, the symposium committee, under the leadership of a university professor, brings teachers and representatives of business and higher education together to plan and implement symposia for collaborative members. In Los Angeles, similar groups plan workshops and bring in guest speakers. And in Memphis, subcommittees of the Advisory Committee address specific curricular issues, such as the content of a course in advanced mathematics. In all three instances, successful networking appears to result from opportunities in which representatives of all sectors are brought together to accomplish an agreed-upon task.

Permanence

During the past year, several of the collaborative sites have begun to explore the organizational and administrative issues that must be decided as they move toward permanence. Their approaches and decisions offer insights into the stability of their various organizational structures and the collaboratives' views of their effectiveness and efficiency. Many of the permanence proposals, for example, include plans to expand the projects' relationships to existing community organizations and to develop new relationships where none have existed before. In the Twin Cities, the collaborative decided to establish a board of directors that would be incorporated as a non-profit organization and that would be open to teachers throughout Minnesota. In Pittsburgh, the collaborative's vision of the future includes a slate of teacher task forces that would be embedded in the organizational structure of the district administration and would involve teachers at the elementary, middle and secondary school levels. In Philadelphia, a position of in-school collaborator is being explored as a part of its plans for permanence. And in

Durham, the collaborative's permanence plans include stronger and more viable relationships with state agencies, so that the Durham Math Council could serve as a model to school districts throughout North Carolina.

As the collaboratives addressed the question of permanence, it became clear in some cases that issues affecting the projects' stability or continuity had to be resolved. In San Francisco, for example, the board of the San Francisco Education Fund, which is the project's host agency, questioned the project's impact on students' test scores and the amount of financial commitment the group would require over the next five years--both questions that merit consideration and response. In the first instance, the board appeared to be interested in issues that are, in fact, only remotely connected to the collaborative's purpose and intent, which is the professional enhancement of mathematics teachers. The budgetary questions, on the other hand, prompted the collaborative to review its fund-raising strategies and to evaluate its program decisions.

Collaboration

Collaboration continues to occur within and among schools, within and among project sites, and between teachers and mathematics professionals from business and higher education. As the project matures, issues related to the ways in which such collaboration can be engendered and sustained become increasingly important. What are the necessary conditions for collaboration? What defines or characterizes an environment that is conducive to the sharing of ideas, or to the inculcation of new ideas and strategies into teaching methods and curricular approaches? What constitutes networking and how can it be fostered and encouraged? Discussion of these issues can be categorized into four topics: collaboration within schools; collaboration across schools; collaboration across sites; and collaboration across sectors.

Within Schools

As noted in earlier annual reports, it cannot be assumed that teachers within a single school building necessarily interact with one another, or that they function as a cohesive group. As a result, one of the goals of many of the collaboratives has been to foster and enhance feelings of collegiality and sharing among teachers within departments. In Philadelphia, for example, mathematics and science departments have been required to hold joint meetings as a prerequisite to collaborative membership, and Sue Stetzer's role as an in-school collaborator has helped encourage teachers within schools to address their shared concerns. In Los Angeles, the collaborative's team-building strategy, which requires teachers to work closely together, has successfully fostered collegiality and group cohesion within departments. In San Diego, the collaborative director and coordinators meet with targeted departments, a practice that has facilitated interaction among the teachers and promoted a common set of expectations and goals. Teachers' appreciation of the impact that the collaborative has had on departments is reflected in the comments of a teacher from Durham: "The members of my department have gotten much training in both subject matter and techniques from programs sponsored by DMC. We have also received materials and equipment as the result of grants. We have been inspired to work harder and teach better." Another teacher from Durham said, "I find that there is more sharing within the department and that the teachers are working harder. Our morale has improved." A teacher from St. Louis concurred: "I spend far more time outside class in cooperative planning with my department head and colleagues than I did previously. The St. Louis Board of Education is getting almost double with zero dollars input."

An important revelation has occurred in many collaboratives over the past three years. It has become apparent that, contrary to initial assumptions, it is not necessary that all of the teachers in a mathematics department subscribe to the collaborative concept right from the outset. It has been the case that, in several sites, some teachers have been resistant to change and therefore reluctant to discuss the benefits or the positive aspects of collaborative participation and membership. Despite this kind of initial resistance, it has been the experience of many of the collaboratives that the effort can succeed where as few as 50 percent of targeted teachers are willing to participate. In Los Angeles, where the +PLUS+ program requires 60 percent of the members of a department to commit themselves to participation, group cohesion has emerged and collaboration has occurred. In fact, as collaboratives continue and expand, many teachers who initially were reluctant to become involved have observed the benefits of participation and are now ready to join their colleagues. In San Francisco, for example, a teacher who initially had refused to affiliate with the collaborative decided to attend the Exploratorium Summer Institute after repeatedly hearing glowing reports from other teachers.

Experience also suggests that collaboration occurs more readily when teachers are engaged in an explicit, well-defined goal or task. Networking and collaboration are not as evident in situations in which teachers are invited to hear a speaker or a presentation without being further invited to use that new information to develop classroom materials or other curricular products. In summary, it appears that when teachers are asked to accomplish something--whether it be to develop a plan or to resolve a curriculum issue--the net result is collaboration and a stronger sense of group cohesion and collegiality.

Across Schools

Collaboration has occurred between teachers from different schools within a single district or geographic region. Prior to their collaborative involvement, a number of teachers were unacquainted with their colleagues districtwide and had few opportunities to interact with them. In many sites, the collaboratives have addressed this widespread professional isolation by bringing teachers together to participate on a teacher's council, to develop and make presentations to other teachers, or to produce curriculum materials. Here again, it appears that the clear identification of tasks facilitates networking and collaboration among teachers to a greater degree than do social events or workshops.

Collaboration is a predictable outcome of the interaction of teachers who serve together on collaborative committees. In Pittsburgh, for example, teachers who sit on the Computer Training Committee have come to view one another as resources for information about specific kinds of software, as well as advice and help in solving programming problems. Members of this committee benefit personally from this interaction and, additionally, they are then equipped to bring their enhanced understandings and updated knowledge back to their schools.

Collaboration among schools within a district also can provide a support network for those who find themselves in positions of isolation as the only teacher of a given course in a school building. In some schools, for example, the higher level courses are assigned based on seniority; in other schools, there are teachers who feel more comfortable teaching Algebra I and other introductory courses because of a limited mathematics background. These teachers often find it difficult to identify a colleague who can answer questions or simply empathize about concerns. By its very nature, interaction with teachers in other mathematics departments offers these teachers an opportunity to meet and to share concerns with colleagues who may be struggling with similar situations or problems. The teachers seem to greatly appreciate the opportunities the collaborative has provided to enable them to get to know their colleagues. A teacher from the Twin Cities commented, "The Twin Cities Urban Mathematics Collaborative has provided a vehicle for me to interact with other math teachers who have many of the same problems as I do. A teacher's role is changing and I have a chance to be aware of what is happening."

The majority of the collaboratives publish a newsletter that is distributed to all of its teachers. In addition to publicizing collaborative events and providing information on key mathematical issues, many of these newsletters provide a forum in which teachers can share ideas and become informed about their colleagues' accomplishments. The newsletter also serves as tangible evidence of the collaborative's role in the community. In spite of the importance of the newsletter, many of the collaboratives have had difficulty identifying volunteers willing to commit the time and effort necessary to produce and distribute the publication.

Perhaps the most striking example of a project's efforts to increase collaboration across schools involves Televenture, an electronic bulletin board through which teachers are able to communicate information, ideas and opinions on critical mathematics issues and concerns. In Los Angeles, for example, +PLUS+ has arranged for all seven of its targeted departments to receive modems and telephone lines so that the ninety-four teachers at those seven schools may participate. During 1987-88, the network was expanded to include several science teachers and district instructional specialists; it is expected that the eight new +PLUS+ departments to be added to the project during 1988-89 also will be equipped to participate in Televenture.

Similarly, the Philadelphia collaborative has established a network in which public-domain and teacher-written software is mailed to teacher participants, accompanied by topic-related print materials. The subject area networks established by the Durham Mathematics Council and the Swap Shops initiated by the Memphis collaborative are further examples of the concerted efforts the collaboratives have made to establish networks among teachers from throughout their districts as a means of fostering enhanced feelings of collegiality and common purpose.

Across Sites

In addition to its efforts within districts, the UMC project has generated significant interaction among teachers across sites. As a result, many collaborative teachers have come to view themselves as members of a national community of teaching professionals and the collaborative sites as individual components of a national network aimed at enhancing the professionalism of mathematics teachers in urban centers around the country. The Technical Assistance Project has worked to bring teachers together at a variety of national conferences and workshops, including the annual meeting of the National Council of Teachers of Mathematics (NCTM), the National Conference on Mathematics Reform and Teacher Professionalism at the North Carolina School of Science and Mathematics (NCSSM), the Geometric Supposer workshops offered in a variety of locations during 1987-88, and the Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy in New Hampshire. Such efforts have been instrumental in bringing the collaboratives closer to their common goal of reducing teachers' sense of professional isolation; in the words of one Los Angeles teacher:

> +PLUS+ has given us a vehicle to meet with other teachers. In 20 years of teaching, I didn't know teachers at other schools, now I know over 100 math teachers throughout the USA. I can go to a national meeting and run into teachers I know from North Carolina. Very few people work well in isolation; knowing others are out there helps.

The Technical Assistance Project further facilitated communication and collaboration among teachers by enabling collaborative members in two sites to participate in Common Ground, an electronic mail network which the Technical Assistance Project has established to facilitate across-site communication among the directors and coordinators of each of the projects. A special forum, for example, was created to allow teachers to share ideas and questions about the Geometric Supposer. In establishing the geometry forum for the teachers in Philadelphia and Los Angeles, the Technical Assistance Project named one of its staff, Grace Kelemanik, to monitor the interaction that was occurring and to facilitate teachers' involvement by posing substantive questions or responding to the comments of others. The TAP also assumed the costs of using the network, including installation of an 800 telephone number, and finally, it invited two teachers who were involved in the creation and field-testing of the Geometric Supposer--Daniel Chazan, director of the Geometric Supposer Research Project, and Richard Houde, a Massachusetts teacher who uses the software and has helped to test it--to participate.

In combination, these efforts were sufficient to encourage fourteen teachers to participate since the forum's inception in October, 1987. The network was initiated with Houde's thought-provoking question: "How do I encourage my students to become a community of learners?" Interactions have addressed problems in using the software, as well as a variety of more philosophical questions teachers have posed about the doing and teaching of mathematics: "What exactly is the 'process' of mathematics?" "How can we get more teachers interested in using the Supposer?"

Participants in the Geometric Supposer Forum have been enthusiastic about the opportunity to share their ideas and experiences with their colleagues in other districts and locales; in this sense, the forums have helped to reduce isolation, have fostered collegiality, and have provided teachers with a positive experience and an expanded view of the value of technology in fostering communication. One teacher expressed her appreciation of the forum: "It is great to share ideas with others who are teaching the same subject. I am the only geometry teacher in my school and thus have no colleague to discuss ideas with. . . . It has provided me with new lesson ideas/strategies, answered pedagogical questions and provided me with the affirmation that I am not the only one with a class that is having trouble with a particular topic." Another teacher wrote, "It was great to get support and share. Our own faculty and administrators don't give us as much support as the members of this forum. Being in the forum I realized I wasn't alone in this attempt."

A third teacher reported that his Common Ground participation had not only enhanced his mathematics knowledge and allowed him to establish relationships with his colleagues at other sites, but had also increased his professional self-esteem. In his words: "I have found the sharing of ideas and information via Common Ground very exciting. Our profession causes us to be isolated. We are isolated in our rooms (having little contact with our colleagues during a school day), isolated with our teaching subjects (an algebra teacher doesn't care what's happening in a geometry class), and isolated with our information. With the onset of new technology, especially the use of the Geometric Supposer, a sharing of new ideas, labs, successes, frustrations, and information has become very valuable. The use of Common Ground has brought professionals together and has opened needed channels of communication. It has made my work seem more important. It has made teaching more fun."

Across Sectors

Generating true collaboration between teachers and representatives of business and higher education is a far more complex process than merely bringing the various sectors together to socialize or hear a presentation of common interest. While such interaction helps to lay the groundwork for future cooperation, it appears that real collaboration occurs most readily when representatives of the various sectors have identified a common need and develop an acceptable avenue by which to meet it. Internship programs are one such example. In New Orleans, two teachers spent the summer of 1988 working for the Port Authority, completing a project that the Port would otherwise have been unable to conduct. The teachers brought their expertise and knowledge of mathematics and statistics to the Port, and they came away from the experience with firsthand knowledge about how mathematics is used in the workplace. In Durham, a site visit program brought teachers to the IBM plant to interact with corporate executives, and in San Diego, teachers visited Teledyne Ryan. In all cases, the collaboratives have realized that these events are most successful when representatives of the teachers and the corporation have an opportunity to meet prior to the teachers' visit in order to define goals and discuss program options.

In general, the collaboratives have found that businesses and institutes of higher education are more than willing to provide resources (including staff, equipment, and funding) to the projects. However, it appears that the most meaningful relationships between teachers and mathematicians from the other sectors have occurred when the individuals involved are interested and motivated. It was the personal commitment of all those involved that led to the success of the +PLUS+ workshops, which were planned and presented by professors, mathematicians and engineers, working with LA teachers. In Durham, the near-perfect attendance of the representatives of business and higher education at the meetings of the collaborative's Board of Directors signals a similar kind of commitment. And in Cleveland, where a businesswoman returned early from New York in order to attend the collaborative's Advisory Board meeting, participants have begun to feel real ownership in the collaborative project and a vested interested in its success and permanence.

In summary, it appears that three key elements are necessary if interactions between teachers and other mathematics professionals are to be successful and productive: 1) identification of common goals and avenues by which various sectors may work to achieve them; 2) planning prior to an event or interaction so that all opportunities are as fruitful as possible; and 3) committed individuals from all sectors so that setbacks or organizational complications can be addressed and overcome without undermining the overall process.

Professionalism

During the first two years of the collaborative project, the Documentation Project of the University of Wisconsin conducted a field survey of 576 teachers in nine of the collaborative sites to measure the views of UMC mathematics teachers about teaching as a profession. In designing the written survey instrument, project staff drew upon current research on professionalism, as well as historical linguistics, to define the characteristics of professionals:

> First, professionals seem to possess, as a result of education, training and experience, some "professed" knowledge that distinguishes them from others. . . . Second, professionals use this specific knowledge when making occupational judgments and decisions. Finally, people in professional occupations possess five important attributes that, taken as a whole, distinguish them from people in other jobs. (Romberg, Pitman, Pittelman, Webb, Fadell, & Middleton, 1988, p. 2)

In 1968, Richard Hall identified these five attributes of a professional:

1. Professional Organization as a Referent. Professionals believe in both a formal organization for governance and the importance of informal exchange with colleagues as the major source of ideas, judgment and identity.

2. Public Service: Professionals believe that they perform an indispensable public service.

3. Self-Regulation: Professionals believe that they should maintain control over their vocation, which includes control of entry requirements and judgments of performance.

4. Sense of Calling: Professionals feel an inner compulsion to their profession.

5. Autonomy: Professionals believe that they should have the freedom to make professional decisions without pressure from other professions, nonprofessionals, or employing institutions.

The discussion that follows draws from the individual site reports, the survey report, and interview data collected in April, 1988.

Professional Organizations

The role of professional organizations in the lives of UMC mathematics teachers was subdivided into two components: organizational support and collegiality with other mathematicians. Teachers responded that such collegiality with their coworkers and with other mathematics professionals is important. Despite this, the majority of teachers indicated that they feel uncomfortable meeting with representatives of business and higher education, even though they also believe that they have something important to contribute to such interactions. Finally, teachers indicated that, while they believe that professional organizations should be on the vanguard of mathematics reform, they are doubtful as to the actual role such organizations play.

One of the most important findings of the survey revealed that teachers who are frequent participants in collaborative activities look to professional organizations for leadership and guidance more so than do noncollaborative teachers. One explanation for this difference may be that the collaboratives have consistently encouraged teachers to participate in their professional organizations; in many cases, the projects have agreed to pay annual membership fees and to help fund teachers' attendance at professional conferences and workshops.

At the same time, however, it should also be noted that as many as 20 percent of all the teachers who responded do not consider their professional organizations as sources of occupational leadership and that as many as 16 percent of teachers active in collaborative events share this view. The question remains whether teachers who are active in their professional organizations are more likely to be involved in the collaborative, or whether teachers' collaborative participation has fostered in them a greater interest in and respect for the professional organizations. Interviews conducted in April, 1988, by the staff of the Documentation Project suggest that both hypotheses are true.

In Philadelphia, the Twin Cities and St. Louis, for example, teachers reported that the collaborative has fostered in them a greater awareness of the benefits of participating in local professional organizations. As a St. Louis teacher expressed: "The collaborative has made me more aware of what's available in the math area. I keep abreast of more organizations and have been involved in more activities." In Cleveland, where the collaborative offered to fund up to fifty secondary mathematics teachers to attend the Ohio Council of Teachers of Mathematics annual meeting, a teacher enthused: "To grow professionally, it is of tremendous value to be exposed to those methods and ideas that have worked successfully for our colleagues, both nationally and statewide."

A teacher from Memphis professed, "MUMC has made us realize that we are not islands. It has definitely been a learning situation for all involved. MUMC has offered us the opportunities and money to attend various conferences and workshops. It has been a real eye-opener." Another Memphis teacher said, "I've met more teachers from other schools and universities and have gotten to know them better. I've learned a lot from their sharing/brainstorming with me at meetings. I feel really good. It's made a big difference in how I feel about myself. I used to just teach, now I like what I'm doing and how I feel about myself as a teacher." A teacher from Durham commented, "Not only do I feel much more professional, I am more professional. My colleagues and students share this opinion. I feel confident in making suggestions and have a sense of being able to make changes."

Public Service

Regardless of site or level of collaborative involvement, the majority of teachers surveyed by the Documentation Project believe that "the teaching of mathematics is essential in our society." Despite this, the surveys revealed that teachers also agreed, on average, that ". . . my work as a math teacher is not appreciated by most people," and that "Math teachers feel that their contribution to society is not recognized by business and industry." These findings suggest that, while mathematics teachers value their own role and contribution to society, they feel undervalued by those they serve.

One of the goals of the UMC project has been to address this perception and to impress upon teachers, as well as the broader community, the vital importance of quality mathematics education. By providing forums in which teachers can interact on equal terms with other mathematics-using professionals, the collaborative is disassembling the barriers that exist between them. By bringing professionals from the various sectors together to address a common problem or to plan and implement a program, the collaboratives are encouraging collegiality and fostering greater public appreciation for the skills and talents of mathematics teachers.

Evidence that these efforts are having some effect is abundant in the individual site reports and in teachers' interview responses. While interaction with their peers remains the most frequently cited benefit of teachers' collaborative involvement, a consistent subtheme is the importance they assign to the opportunities they have to interact with other professionals. As one San Francisco teacher reported, ". . . in the past, I felt that no one really cared. . . . Being wined and dined by the executives of Chevron does a lot for me: being up there where the Chevron board meets, hearing a Nobel Prize winner speak. . . ." In the Twin Cities, the Twin Cities Pre-College Mathematics Society sponsors a series of dinner meetings designed to bring together mathematics teachers and mathematicians from industry and higher education, and in Memphis, the Resource Associates program matches teachers with representatives of business and higher education in one-on-one partnerships for their mutual benefit. Clearly, the collaboratives have made some progress in establishing and enhancing the relationships between teachers and other mathematicians. In turn, these relationships have served to inform the greater communities served by the collaboratives of the value and importance of the service provided by secondary mathematics teachers in our nation's inner cities.

Teachers' comments suggest that they have come to understand that their collaborative involvement not only enhances their own professional self-esteem, but increases their status in the community at large. According to a teacher from Durham: "The teachers who participate have a much better self-image. They are more confident and recognize that they are truly making a contribution. These teachers have an attitude that has permeated the department and served to make us better teachers and more effective teachers." A teacher from the Twin Cities concurred: "They [my students] are aware that I attend conferences and that I still go to school; they have told me that they feel that this is good; parents have also shared this idea. I am excited about teaching mathematics and this does help to excite and motivate my students."

Self-Regulation

The belief that self-regulation is important inheres the premise that, because professionals are experts in their content area, they should be responsible for developing standards and monitoring and evaluating their colleagues. Participants in the UMC survey indicated that, while teachers should be involved in evaluating and monitoring their peers, representatives of other professions or organizations would also be qualified to conduct such evaluations. Further, teachers indicated that they believe that parents are not, as a group, sufficiently trained in the subject area to evaluate the mathematics instruction of their children.

Statistical analysis of the survey results indicated that teachers who were frequent participants in collaborative activities were somewhat more likely to support self-regulation than were their colleagues who infrequently or never attended collaborative events; even so, however, only 7 percent of all teachers surveyed disagreed with the notion of professional self-regulation. Asked, for example, whether teachers were involved in peer evaluations and whether they should be, one teacher responded: "In recent years, the evaluation form is part of negotiations, the last form was done through negotiating. It makes sense to involve teachers. It's more productive."

Sense of Calling

Within the context of the UMC survey, the term sense of calling as an indicator of professionalism refers to the commitment that a teacher feels to his or her work. Survey results suggest that teachers enjoy their work and feel a sense of dedication to their jobs, but that many do not feel so committed that they would remain in the classroom in the face of salary reductions. Teachers have reported that the collaboratives have had a positive impact on their sense of calling to the teaching profession; teachers seem energized by their project participation. In the words of a teacher from the Twin Cities:

"I am much more excited about my daily teaching. I am willing to try new things, taking risks that I usually never did. The sharing and visiting is adding much to my confidence in this area." A teacher from Philadelphia reported, "I gave a presentation at Germantown High School. I am going to Memphis to give a presentation. I am giving a workshop at our school. I had given up going to these things because I was bored to tears. I have become a presenter. My teaching life is changed. I enjoy the change. This has given me a venue to dive right in." A teacher from Durham seems to share the opinion that the collaborative has increased teachers' motivation and dedication to their profession: "The attitude of the teachers has been the most significant change. All seem to be proud of what they do. They have developed an enthusiasm that was absent before the DMC was created. They are willing to present programs and to ask for grants."

The survey results confirm that teachers who participate frequently in collaborative events are feeling a greater sense of calling to the teaching of mathematics. They are working harder and are more excited about their subject area than are teachers who infrequently or never participate in their local collaborative. In evaluating this finding, it should be noted that it is as yet unclear whether those who have a higher sense of calling are more likely to participate in collaborative events, or conversely, whether collaborative participation is instilling in these teachers a greater sense of commitment to their work.

Autonomy

The fifth of Hall's attributes of a professional is autonomy, which, in this context, refers to teachers' desire to direct their own behavior and to make their own professional decisions without pressure from outside sources. The individual site reports, as well as the interview documentation, are replete with evidence to suggest that teachers' sense of autonomy has been enhanced by their collaborative participation. In the Twin Cities, the Building Representatives group meets regularly to engage in discussions about substantive issues of mathematics, learning theory, and pedagogy. In St. Louis, teachers have taken the initiative to plan and organize a mathematics contest and a mathematics fair. In Los Angeles, a geometry teacher has been empowered to dispense with the standard text in order to allow his students greater mathematics creativity in generating their own activities centered on the Geometric Supposer. In Pittsburgh, a committee of five teachers and a mathematics supervisor is redesigning the curriculum of the district's three-year General Mathematics sequence, and in New Orleans, ten public school teachers applied for and received a total of $4,478 in mini-grant funds to support mathematics-related projects. In all eleven sites, teachers have begun to take the initiative to improve and enhance their own mathematics skills, and therefore the mathematics instruction of their students. As one San Diego principal commented: "A fire has been lit under our teachers. As they go to workshops and get different ideas, they come back and want to do things. The school has found some money to support them." In New Orleans, a departmental chair attributes a new vigor and sense of empowerment among mathematics teachers to their collaborative participation: I find that teachers involved in the collaborative have a new optimism--they are coming back to school with new ways of teaching some difficult topics."

In both Durham and Memphis, teachers credit the collaborative with giving them opportunities to be involved in decision-making procedures and to have more input regarding the curriculum they are teaching. A teacher from Memphis reported, "I feel more involved in decision making that affects math teachers. I feel more like a professional. I think I'm more active rather than just accepting curriculum situations as they are." A teacher from Durham said, "We are much more together as a group. We have joined professional organizations. We feel much more professional. We are motivated and excited. We no longer teach just that which we are given but have some input into curriculum."

In summary, it is clear that the collaborative projects are providing opportunities and substantive support to enable a large number of teachers to participate and to assume leadership roles in a movement to enhance their own professionalism and to institute curricular reform at the school level. Through the collaboratives, teachers enjoy increased access to the knowledge bases of both mathematics and pedagogy; they are experiencing more recognition from their peers and colleagues in the mathematics-using community; and they are being encouraged and assisted to make greater use of their professional organizations. As teachers become more active, involved collaborative participants and as the projects themselves work toward permanence, it can be expected that the collaboratives will play a key role in improving teachers' perceptions of their own professionalism.

Mathematics Focus

Although each collaborative is responsible for defining its own mathematics focus, at least two events during the past year have helped to shape and to identify a broader mathematics focus for the UMC project as a whole. In April, 1988, the Technical Assistance Project held two meetings for the collaborative teachers in attendance at the NCTM Annual Meeting in Chicago. One session focused on the NCTM *Curriculum and Evaluation Standards for School Mathematics*, and the other on the Geometric Supposer.

In July, 1987, teachers from each of the eleven collaboratives were invited to participate in a summer institute on the pre-calculus curriculum at the North Carolina School of Science and Mathematics.

These activities, which involved teachers from all of the collaboratives, have helped to enhance teachers' awareness of current efforts for reform to such an extent that changes have begun to occur. Five of the sites held workshops, meetings, or discussions on the new NCTM *Standards* during the year. At many of the other sites, the *Standards* were publicized and a draft of the document was made available to teachers. Asked how her awareness of current trends in mathematics education has increased because of the collaborative, a Durham teacher responded, "My . . . introduction to the NCTM *Standards* has . . . come from DMC. Our state department of education has done nothing for the classroom teacher." A Memphis teacher noted, "I attended NCTM and felt really on top of national trends. I read more and feel more up-to-date on the *Standards* and other classroom teaching models." A Philadelphia teacher responded, "The NCTM *Standards* have been a topic of conversation within our department." A San Diego teacher agreed: "Oh, definitely, because of going to the national conference and also the *Standards* workshops. I had heard the term '*Standards*' tossed around but did not know what it meant until we became involved in the collaborative." A teacher from Cleveland observed, "Yes. I am aware of the new *Standards* in mathematics and am working actively to implement them in my classes and in my department."

These enthusiastic comments are in stark contrast to the uninformed skepticism of a high school mathematics teacher who is not a collaborative member. Asked to respond to questions about the NCTM *Standards*, he wrote, "It is my opinion that [the *Standards*] are a little naive. There is no provision in [the document] to explicitly state what teachers should teach. . . . To expect [teachers] to form a grassroots movement that is supported by the [document] . . . is naive. These teachers simply do not have the time to develop curriculum on their own and very few districts will pay to implement curriculum of any kind."

The use of technology in the mathematics curriculum is another focus common to many of the sites. This topic is embedded in the NCTM *Standards* and was central to the NCSSM pre-calculus course materials. Innovations such as the Geometric Supposer and the calculator projects underway in several sites exemplify the changes that are occurring as a result of the collaborative project. Most important, this technological innovation is not centered on the use of technology for its own sake, but on technology's capacity to free teachers from traditional notions about what mathematics is and what it can ultimately become. In describing the effects of the collaborative, a Durham teacher reported, "The Durham Mathematics Council has broadened my definition of the responsibilities and opportunities of a mathematics teacher. I now see the areas in which I can be influential in determining curriculum. I am more aware of the changes which technology is making that will affect the needs of all students." A Cleveland teacher noted, "I've been more aware of mathematics instruction as a tool to keep up with modern technology. The calculator/computers are to be infused within our daily lesson plans. New courses such as Discrete Math are a wave of the future."

A third general focus shared by many collaboratives has involved mathematics applications. Site visits to industries, internships, and presentations by representatives of business and higher education have contributed significantly to teachers' knowledge in this area. One of the most valuable features of the site visits have been the sets of application problems produced by businesses and distributed to the teachers.

Not all collaborative activities have been directed toward reform. Some collaboratives have focused their attention on the courses being taught and the everyday problems teachers encounter in the classroom. These kinds of activities typically involve a social event or occasion during which teachers are afforded the opportunity to interact, to network and to share ideas. Examples include the Swap Shops held in Memphis and the subject area networks in Durham. In both of these activities, teachers are grouped by courses, such as general mathematics, algebra, geometry, and advanced algebra. Discussions or demonstrations center on specific activities that can be used with students in the classroom. Teachers who have attended these meetings have been very positive about their value. "I really enjoyed the [Swap Shop] workshop!" said one Memphis teacher. "It helps me to understand that I am not in this boat alone! We all have the same problems."

In addition to their efforts to enhance the professionalism of mathematics teachers, the collaboratives continue to offer or sponsor a variety of activities that are student-centered. Mathematics contests, such as those held in the Twin Cities, Cleveland, and St. Louis, have been the most prevalent student-directed activities developed by the collaboratives. Organization and planning of the activities offers opportunities for teachers to work with their peers, and with people from higher education and business. This interaction, in and of itself, has benefitted teachers. But the most important outcomes of the contests have been the opportunities teachers and students have had to do mathematics together, in preparation for the contests. Similarly, the grant awarded to the Cleveland collaborative to sponsor mathematics clubs in the Cleveland senior high schools and the Mathematics Fair initiated by the St. Louis collaborative are other examples of student-centered project activities.

Finally, a number of collaboratives have focused on such curricular topics as problem solving, discrete mathematics, and statistics. These and other innovative approaches to the teaching of mathematics have brought a renewed vigor and excitement to what teachers are doing and how they view themselves. Asked about the effects of the collaborative, a Cleveland teacher said, "Because of the collaborative my whole attitude toward teaching math has changed. Through things like the problem-solving workshop, calculator workshop, dinner meetings, math clubs, math resource center, etc., I have become rejuvenated and motivated in a whole new light. This has taken place at a time when I was seriously considering getting out of teaching after 18 years. I can honestly say the collaborative has changed my mind."

Since their inception, the collaboratives have progressed through a series of stages as they move toward maturation and permanence. Initially, the projects viewed their role as one of providing opportunities for teachers to meet and to discuss mathematics. Typically, the projects sponsored a variety of workshops, meetings, symposiums, and institutes from which teachers could pick and choose. The range of topics included applications, use of technology, geometry, and other general curriculum areas. At least two collaboratives identified a mathematics focus from the outset: Cleveland and Twin Cities stressed problem solving in the activities they sponsored. But in all cases, programmatic change was not originally viewed as an issue. As the collaboratives have matured, however, program issues have emerged as an important focus of their efforts. In Pittsburgh and Philadelphia, for example, the collaboratives are addressing a third-year mathematics course for non-college bound students. Two of the California collaboratives, Los Angeles and San Diego, have used the *California Mathematics Framework* (California State Department of Public Instruction, 1985) as a guide for planning workshops. In San Diego, a school principal has turned to the collaborative staff for help in developing a viable alternative to general mathematics courses in the senior high schools. The Durham Mathematics Council and the NCSSM have provided leadership in establishing a technology-driven pre-calculus course. The Memphis collaborative council spent time this year discussing the characteristics of a course that would replace the non-AP calculus course currently offered. What these developments have in common is their shared focus on programmatic change, an emphasis which seems to have evolved out of the collaboratives' maturation and the realization that change in the mathematics curriculum is a necessary condition to change in the professional lives of teachers. It is important to note that change is occurring because teachers have seen the need and have done what is necessary to make it happen.

V. FINAL COMMENTS

The Urban Mathematics Collaborative project is a huge, field-based experiment that is wrestling with some of the most basic and fundamental issues confronting educators today: the professional lives of teachers, their support networks, and their content knowledge. Each year, the Documentation Project has collected a wealth of information from a number of sources, synthesized this information, and garnered from it insights into the world of teachers that have implications for staff development, teaching, schooling, professionalism, and interaction between professionals across sectors. This, the fourth year that the UMC project has been documented, was a pivotal year in that seven of the collaboratives were addressing the issue of permanence, specifying in some detail how they intended to wean themselves from the Ford Foundation's support in order to form a lasting structure founded on their own local resources. This process was revealing, both in terms of the light it shed on the collaboratives' foundations and networks, and in the insights it offered as to the value of the information that had been collected through documentation. Reflecting on the 1987-88 school year, it is possible to begin to conjecture about the impact of the collaboratives and the UMC project, and it is important to continue to analyze the value of documentation as a viable means of inquiry for the study of education and the evaluation of an on-going project.

Impact

At this point in their development, the collaboratives have had time to formulate plans, to establish their structures, to sponsor events and activities, and to begin to have an impact. As has been noted, the collaboratives are in many ways unique, each influenced and characterized by local conditions and demographics. In fact, the collaborative sites were selected initially to represent a broad spectrum of urban environments, and it is thus reasonable to expect that impacts will vary from site to site. Individual situations and results are presented in the summary reports. This discussion, instead, addresses the impacts of the UMC project that appear to be common across sites. As the collaboratives mature over the next two years, the Documentation Project will continue to collect data to support and substantiate these preliminary observations.

The collaborative project appears to have drawn mathematics teachers into more full and active participation in professional activities and events. Teachers frequently report that, for the first time, opportunities and funding have become available to enable them to attend professional meetings and conferences. Some teachers have attended NCTM annual meetings for the first time. Others have begun to make presentations at professional meetings. Still others have renewed their participation in state mathematics organizations, an interest which had waned over time. An important incentive for teachers' increased activity is the availability of funds to sponsor their attendance at such professional events, but the collaborative's contribution exceeds simple funding. In addition to publicizing events and encouraging teachers to attend, the projects have worked with local school districts to obtain teacher release time and, just as important, have engendered in teachers an expectation that the new knowledge they obtain at such events will be shared with their colleagues.

Increased interaction and collegial support among teachers is another apparent result of the collaboratives' efforts. In many cases, teachers have begun to schedule and attend regular departmental meetings, to share their classroom experiences and concerns, to plan workshops for their coworkers within and across schools, and to interact across an electronic network with their colleagues nationwide. All of the collaboratives have sponsored activities designed to bring teachers together and to foster collegiality; in addition, the organizational structures of many of the projects establish a forum in which teachers are encouraged to cooperate to achieve common goals. All of these activities have fostered in teachers a new sense of their membership in a professional community and a new appreciation for the benefits of collegial support.

A more subtle but equally important impact of the UMC project can be seen in teachers' willingness to avail themselves of opportunities for professional enrichment and in their openness to new ideas and approaches. As noted in the context section of this report, change--both in administration and in policy--has become the norm in many of the school districts in which the collaboratives are located. In addition, the past four years have brought nationwide efforts toward curricular and mathematics reform. Collaborative teachers appear to be flexible and enthusiastic enough to take full advantage of the opportunities this era of change represents. In Pittsburgh during 1987-88, for example, teachers were assertive and positive in deciding how they would use the weekly period set aside for TIP (Teacher Interaction Period). According to one mathematics teacher, departments in other content areas experienced a more difficult time deciding what to do. On another front, many collaborative teachers are interested in the NCTM *Standards* and have become actively engaged in learning more about them and how they can be implemented. The collaboratives have been instrumental in this effort to introduce the *Standards*; sessions were presented by the Technical Assistance Project at the NCTM Chicago annual meeting, and individual collaboratives, such as New Orleans and Philadelphia, have offered their own workshops and seminars.

Further, it is clear that collaborative teachers are taking the initiative in introducing and implementing new ideas. This leadership is more than a predisposition toward change; it is, instead, a concerted, earnest effort to provide direction for change. Some teachers have developed new courses, such as the Los Angeles teacher who is planning a new course on discrete mathematics. Others are now using technology in their classrooms as a result of the in-services they have attended through the collaborative. A teacher from the Los Angeles collaborative is teaching a geometry course for the first time without using a textbook; his students are writing their own. From the support of the Durham Mathematics Council, teachers in the Durham area have developed a new computer course and problem-solving materials. St. Louis mathematics teachers, for the first time, conducted a mathematics contest and fair.

All of these developments were possible because the collaboratives have established an environment conducive to change. Teachers are learning more about new approaches for teaching mathematics and the use of technology. They are being encouraged and supported to try new ideas. It will be interesting to note whether, over the next two years, resistance from the district and from principals will deter or even eliminate the innovations teachers have begun to adopt.

Collaboration's impact upon the relationships between teachers and representatives of business and higher education is more difficult to identify. While several teachers have become involved in interactions with other mathematics-using professionals, their numbers have been more limited than those who have participated in other forms of collaboration. In addition, the level of interaction between representatives from business and higher education and mathematics teachers has varied greatly from collaborative to collaborative. Nearly all sites have arranged for teachers to visit businesses and factories to observe how mathematics is used in the workplace. Teachers who have participated in these business visits have enjoyed the experience, have appreciated being well treated by their hosts, and, in some cases, have received problem sets for use with their classes. The most meaningful visits were those in which collaborative and business representatives met prior to the event to identify those applications that would be most relevant to the teachers. Another consideration is that mathematics courses are generally organized by mathematical topic, while businesses focus on problems that may require an integration of mathematical topics. This suggests the need for preparation and interaction between the collaboratives and their hosts in order to design the event so that it is as valuable as possible; it has become apparent that a sustained working relationship among the various sectors requires a concerted effort. Despite collaboratives' best efforts, however, teachers report that, while these events have increased their awareness of how mathematics is being used, site visits do not have a major effect on what they do in the classroom and on how their students know mathematics.

At another level, some collaborative teachers serve on boards or committees with those from business and higher education, thereby working with these professionals to resolve collaborative issues. In these forums, representatives of all three sectors come together on terms of equality; each individual offers a unique and valuable viewpoint drawn from his or her own professional experience and expertise. Unfortunately, only a handful of teachers from each collaborative are afforded the opportunity to serve on such committees. Over the next two years, it will be important to monitor the impacts of this kind of interaction in order to determine how this form of collaboration affects teachers' professional lives.

In addition to the collaboratives' impact on teachers' relationships with their colleagues and with mathematics-using professionals in other sectors, they also have changed the interactions between teachers and district administrators and mathematics supervisors. Many of the collaboratives have established themselves as viable sources of staff development and teacher leadership. In many sites, the collaboratives have been instrumental in establishing committees focused on testing, curriculum, and other educational issues. In Cleveland, because of the close cooperation between the district mathematics supervisor and the collaborative, mathematics teachers have helped to write district mathematics tests. In Memphis, collaborative activities complement the district in-service efforts such that the curriculum supervisor uses collaborative activities as in-services for secondary teachers, a situation that allows her to focus on in-service for teachers in the elementary grades. In St. Louis, the collaborative field tests new activities that may be sponsored by the district at a later date. In Los Angeles, the collaborative has enabled many teachers to meet with the mathematics supervisor for the first time. One Los Angeles mathematics teacher accompanied the district superintendent to Seattle and made a joint presentation at the Council of Great City Schools conference.

Information collected by the Documentation Project suggests that the collaboratives are having an effect on teachers and their professional lives. Teachers from all collaboratives have responded positively to questions about the collaboratives' impact. As we continue to gather information on the impact of the collaboratives, we are also beginning to gain more understanding of collaboration, administrative structures, and contextual factors, and how these relate to renewed professional interest, the reduction of teachers' sense of isolation, innovation in classroom teaching, and increased interest in recommended changes to the mathematics curriculum. As the collaboratives work towards permanence and our data base is expanded, the UMC project's impacts on the professional lives of teachers will become more readily apparent.

The Documentation Process

Each year, as we prepare this annual report, the value of the process is reconfirmed. In calibrating and validating the information we have collected and interpreted with the individual sites' administration, we find that information is adjusted, clarified, reinterpreted, and added. In one case, for example, we had not documented all of the steps a collaborative had used in preparing its permanence proposal and our report on teachers' involvement needed expansion. In other cases, more information was needed before we could present an accurate, detailed description of an event and the collaborative's role in it. In still other cases, clarification was needed as to the collaborative administration's decision-making process. To construct this report annually is to synthesize and become well versed in the voluminous information collected each year; the process itself illuminates our understandings of the project and how it is evolving.

The process by which the annual reports are prepared is of value to the eleven collaboratives as well. In some collaboratives, reviewing the draft report involves discussion between the project and the district administration, thereby providing an opportunity for administrators to focus on the collaborative and discuss its activities. For some collaborative directors, the report helps to enhance their perceptions about teachers' views and reactions to project activities and is therefore a useful tool for planning. Finally, the reports offer a brief history of the development and activities of each site, a body of information that has been of particular value to collaborative administrators new to the UMC project.

As the project has matured, the documenters and the Documentation Project have become more immersed in the overall project. During 1987-88, documentation information and the opinions of the documenters contributed to decisions about possible interventions and the technical assistance that would be most useful. Documenters were asked to react to permanence and grant proposals, and to provide information about such issues as the NCTM *Curriculum and Evaluation Standards*. As a result of this ongoing interaction, the Documentation Project's vested interest in the total UMC project prohibits strict objectivity as it draws its conclusions. In exchange for pure objectivity in its reporting, the Documentation Project has achieved a relationship with the eleven projects founded on mutual respect and trust--the importance of which cannot be overemphasized. On a recent visit to one of the sites, for example, the collaborative coordinator confided to the documenter that she was unsure as to what was going to happen at the Advisory Board meeting that they were to attend. Some key decision makers who had not been at previous meetings were expected to attend to offer advice on the collaborative's permanence proposal. Because of the trust that had been developed, the coordinator was comfortable having the documenter in attendance at the meeting, even though it could have been a disaster. As it turned out, meaningful interaction concerning permanence took place among the eight people who did attend.

Similarly, the Documentation Project's on-site observers have, for the most part, become very active in their collaboratives. Eight of the eleven on-site observers are practicing teachers. Nine of the eleven serve on some decision-making body for their respective collaboratives or are very active in affecting the project's goals and direction. As such, in nearly all of the sites, the on-site observer has assumed a key role in the collaborative that exceeds mere reporting. In developing the on-site observer aspect of the project, documenters decided to pay each observer for 25 hours each month to attend activities and meetings, and to draw upon the observers' perspectives in fine-tuning the entire project. At the UMC annual meetings, for example, the on-site observers make a valuable contribution to the event and bring a unique perspective to the discussions. The role of the on-site observer is not only critical to the documentation process, but has evolved into an important source of collaborative leadership as well.

As a final comment, documenters spend many hours visiting sites, talking with teachers, visiting classrooms, attending meetings, and processing information. Professional interests motivate their involvement: they are eager to learn more about education and to become involved in a project that is having an impact on a large number of teachers. Out of this familiarity with the various sites has emerged a true appreciation and respect for the commitment of those in the collaboratives and their dedication to making the project work. Documenters have been particularly impressed by the sincere effort that went into developing the permanence proposals and in teachers' continual affirmation of their concern and interest for their students and their education. In addition to these professional interests, documenters experience a sense of personal gratification that comes from getting to know teachers, collaborative staff, business people, and academicians at all of the sites. The collaborative effort is characterized by widespread collegiality, friendship and support. It is more than a project to enhance the professional lives of teachers, although that remains its central goal. In addition, the project has evolved into a strong and influential network of educators and other professionals, working together to initiate and support change.

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APPENDIXES

SUMMARY REPORTS FOR THE ELEVEN URBAN MATHEMATICS COLLABORATIVES

A. Cleveland Collaborative for Mathematics Education (C^{2}ME)
B. Durham Collaborative: The Durham Mathematics Council
C. Los Angeles Urban Mathematics/Science Collaborative (LAUM/SC)
D. Memphis Urban Mathematics Collaborative
E. New Orleans Mathematics Collaborative (NOMC)
F. Philadelphia Math Science Collaborative
G. Pittsburgh Mathematics Collaborative
H. St. Louis Urban Mathematics Collaborative
I. San Diego Urban Mathematics Collaborative
J. San Francisco Mathematics Collaborative
K. Twin Cities Urban Mathematics Collaborative

The following reports are brief summaries of each of the eleven urban mathematics collaboratives funded by the Ford Foundation. Although the reports were prepared by staff of the Documentation Project, the content of each report was approved by the project.

SUMMARY REPORT:
CLEVELAND COLLABORATIVE FOR MATHEMATICS EDUCATION (C^{2}ME)
by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Cleveland Collaborative for Mathematics Education (C^{2}ME) during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Cleveland collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

CLEVELAND COLLABORATIVE FOR MATHEMATICS EDUCATION (C^{2}ME)

A. Purpose

The purpose of the Cleveland Collaborative for Mathematics Education as stated in its proposal for continued funding is:

1. to provide professional enrichment opportunities for teachers;
2. to provide opportunities for teachers to increase their understanding of mathematics and its current applications; and
3. to facilitate sharing, communication, networking, and collegiality among teachers and mathematicians from business, industry, and higher education.

To accomplish these goals, C^{2}ME has developed a four-year work plan in cooperation with the Cleveland Public Schools and participating teachers. The plan specifies participants and outlines activities designed to enhance the collaborative's efforts to advance and reform the secondary school mathematics curriculum of the Cleveland Public Schools.

B. Context

Cleveland, a city of 536,000 residents, is situated in a metropolitan area with a population of more than 1.8 million. The Cleveland Public Schools (CPS) district consists of 128 schools, including twenty-two intermediate schools (grades 7-8) and twelve high schools (grades 9-12). In addition, the district has nine magnet schools and one school for special populations.

During 1987-88, the CPS district enrolled approximately 73,000 students: 35,000 females (48 percent) and 38,000 (52 percent) males. Enrollment over the past fifteen years has followed a steady, sharp downward trend, from a high of 145,000 students in 1972-73 to the current low of 73,000. During the same time period, the district's ethnic mix has changed from 57 percent black and 40 percent white in 1972-73 to 70 percent black, 24 percent white, 5 percent Hispanic, and 1 percent Asian in 1987-88. Approximately 4 percent of district students have English as a second language, and 68 percent are eligible for federally funded lunch programs. A significant number of students living within the district boundaries attend private schools (25 percent).

Approximately 20,000 students attend high schools in the CPS district. Of these, 74 percent are black, 21 percent are white, 5 percent are Hispanic and 1 percent are Asian. There are approximately the same number of boys as girls. Forty-eight percent are eligible for federally funded lunch programs. The dropout rate for the 1987-88 school year for grades 7-12 was 9.6 percent.

CPS graduation requirements vary, depending on students' course of study. Vocational, business and general students are required to take one unit of science and two units of mathematics, while pupils in the college preparation course of study are required to take three units of science and three units of mathematics. In 1987-88, 38 percent of Cleveland ninth graders scored in the range considered below average in mathematical computation, compared to the norm of 23 percent in the national sample, on the California Achievement Test. Fifty-seven percent of ninth graders scored in the average range, and 5 percent scored above average, compared to the norm of 54 percent and 23 percent, respectively, in the national sample.

Approximately 15,000 CPS high school students were enrolled in mathematics during the 1987-88 school year. Fifty-two percent of these were males and 48 percent were females. Seventy-six percent of mathematics students were black; the racial composition of the remaining 24 percent was unavailable. Of the total, 41 percent of mathematics students are in the ninth grade.

Approximately 1,300 teachers are employed by CPS high schools. Of these, 52 percent are women and 48 percent are men. Fifty-nine percent of high school teachers are white, 40 percent are black, and 1 percent are Hispanic. The average teacher salary for the 1987-88 school year was approximately $29,000. All CPS high school teachers belong to an active teachers' union. The current contract was approved in September of 1987 and will be in effect until September of 1990.

During 1987-88, the district had ninety-seven high school mathematics teachers. Sixty-eight percent are men and 32 percent are women. Seventy-three percent are white, 25 percent are black, 1 percent are Asian and 1 percent are Hispanic. All of the district's high school mathematics teachers are certified in their subject area, and 70 percent are tenured. In addition to the district's ninety-seven high school mathematics teachers, there are seventy-one who teach mathematics at the intermediate level; of these, 53 percent are male, and 47 percent are female. Approximately 46 percent of the intermediate teachers are black. Seventy-two percent have secondary certification, 10 percent have elementary certification, 6 percent are certified in both, 1 percent do not have certification, and the certification of the other 11 percent is unknown. There also are eighteen who teach mathematics at magnet schools, approximately 30 percent minorities and 44 percent females. The total number of mathematics teachers eligible to participate in the collaborative was 186.

Dr. Alfred D. Tutela has been superintendent of the CPS system for more than two years. By reputation, his attributes include his attentiveness to district desegregation efforts, his strong rapport with the School Board, and his determination to hold teachers accountable for their effectiveness. The district's budget in 1988-89 will reach $451 million, $45 million of which will fund new programs. At the same time, expected revenues total only $383 million, a $68 million shortfall. Measures for reducing the projected deficit include staff reductions, twelve-month magnet schools, and state payment of desegregation costs. The state contributed $17 million, but voters in August, 1987, defeated a $30.4 million tax levy; only 17 percent of eligible voters went to the polls. During the year, the voters approved $60 million for capital improvements which included $8 million for technology that would be used to upgrade equipment for vocational education and to purchase computer-aided design (CAD) equipment.

In January of 1988, 95 percent of CPS teachers voted to strike over issues that included low salaries; longer work days, from 6.5 to 7.75 hours per day; and an increase in the number of annual work days, from 182 to 215 by 1991. Another topic of dispute was a proposed career ladder, by which teachers could receive more pay, thereby increasing their salaries while they remain in the classroom. Many teachers argued that the proposed work ladder favored new teachers while it ignored seniority and educational experience.

The strike ended after six days when teachers accepted a 3 percent increase in wages for 1988-89, with another 3 percent increase during 1989-90 and future raises contingent upon tax levies. The work ladder issues remained unresolved. The union was unwilling to concede to such a plan without assurances of adequate funding, supplies and working conditions. Most teachers were dissatisfied with the agreement, but were unwilling to continue the strike. Many felt that the union leadership had sold them out. As a result, a new union president was elected.

C. Development of the Collaborative

The Cleveland Collaborative for Mathematics Education experienced changes in its leadership during the 1987-88 school year. The consistently smooth operation of the collaborative throughout these administrative transitions can be attributed in large part to its actively involved Advisory Board and its sound organizational structure. In September, 1987, Paula C. Fay, Director of the Cleveland Education Fund, announced that she was moving to Connecticut and submitted her resignation, effective October 30. Ms. Fay had been very involved with the collaborative from its inception and was instrumental in managing its operation. One of Ms. Fay's particular contributions to the project involved the networks she had established with those in corporations and higher education.

The Education Fund Board initiated a search for a new director. Ms. Barbara Patterson was appointed effective February 29, 1988. Prior to joining the collaborative, Ms. Patterson was the Director of Development and Dean of Institutional Advancement at Gilmour Academy in Gates Mills, Ohio. A lifelong resident of the Cleveland area, she had also served as a lecturer in English at John Carroll University and as the executive director of the Women's City Club of Cleveland. During the period that the Fund was without a director, its operations were directed by Advisory Board Chairman William Madar, and Mr. Joe Flynn, the director of the science collaborative, who also was appointed acting director of the Education Fund.

Suzanne Haggerty continued as collaborative coordinator on a half-time basis, until mid-February, 1988, when she requested a reduction in her hours to 10 hours per week. Her efforts were focused primarily on the preparation of the final proposal to the Ford Foundation. Due to a heavy course load at Oberlin College, however, it became necessary in early March for Ms. Haggerty to resign. On June 27, 1988, Charniece Buford assumed the full-time position of collaborative coordinator. A communications graduate of Cleveland State University, Ms. Buford has worked for the Urban League of Greater Cleveland, Control Data Corporation, and Warfield Communications. For the interim period of four months between Ms. Haggerty's departure and Ms. Buford's arrival, the collaborative operated without a coordinator. Robert Seitz, a mathematics teacher and, beginning in September, 1987, the department head at John Adams High School in Cleveland, is the on-site observer.

Advisory Board

A thirty-eight member Advisory Board, up from thirty-two members in 1986-87, oversees the operation of C^{2}ME. Members of the Advisory Board include scientists, engineers, mathematicians, educators (secondary and post-secondary), and people from finance, accounting, and applied mathematics (product design and technological advancement). In addition, nine Cleveland Public Schools mathematics teachers and Bill Bauer, the district supervisor of mathematics, serve on the Board.

The Advisory Board has four standing committees. The Strategic Planning Committee engages in long-range planning and identifies and mobilizes financial resources. The Program Committee works closely with the Teacher Advisory Board to develop and implement programs and to maintain the link between teacher needs and these programs. The Teacher Advisory Board advises the collaborative's Board on issues of particular importance to mathematics teachers, the evaluation of C^{2}ME programs, and needed programs. The Public Relations Committee publicizes the C^{2}ME to the Cleveland community.

The Advisory Board met on Mondays after school five times during the school year, with an average of eighteen members in attendance at each meeting. In October, Joie Drouhard, Zone Manager of IBM's National Marketing Division and a member of the Cleveland Education Fund Board of Trustees, was elected as chairperson. Meeting topics included updates of the C^{2}ME programs, the budget, figures on teacher participation in collaborative activities, future directions and public relations, the impact of the collaborative on teachers, the Mathematics Teachers Resource Center, and the relation of the collaborative to collaboratives in other content areas. The standing committees met on an as-needed basis throughout the year.

Teacher Advisory Board

The Teacher Advisory Board (TAB) was expanded from eleven to eighteen members in September, 1987. Board members were selected based on criteria designed to insure an equal representation of intermediate and secondary teachers; it was also required that Board members were currently teaching mathematics. Richard Wittman, a high school mathematics teacher, continued to act as TAB spokesperson. The Board met in September, March, and May. At its September meeting, the group brainstormed about program ideas. Topics of discussion included: Continuing Education Credits for teachers' attendance at collaborative activities; ways to encourage departments to meet at the Resource Center; ways to allow teachers to borrow Center materials; how to improve the visibility of the collaborative with the School Board; how teachers can share teaching tips with one another; and increasing teacher membership in professional organizations. At the March meeting, teachers who had attended the Ohio Council of Teachers of Mathematics meeting on March 18-19 reported on their experience. At its May meeting, the TAB reviewed and worked on the permanence proposal.

Strategic Planning Committee

The fourteen-member Strategic Planning Committee was primarily responsible for developing the permanent-state document and financial plan. At its first meeting in January, subcommittees were established and April was set as a target deadline for the first draft of the proposal. The Teacher Advisory Board, along with Bill Bauer, drafted a four-year plan that was reviewed by the Strategic Planning Committee. The narrative for the proposal to the Ford Foundation was written by a four-member Writing Subcommittee, which included Ms. Drouhard, Ms. Pence, Ms. Hardis, and Ms. Patterson.

Public Relations Committee

The Public Relations Committee did not meet as a whole during the school year. A chairperson, who was identified by the Advisory Board, worked actively with the symposium committee.

Support Staff

Prior to 1987-88, the collaborative had paid a teacher to edit the newsletter and to staff the Teacher Resource Center. In April, 1987, the Cleveland Education Fund sent to all secondary mathematics teachers applications for the positions of Center manager and two assistants. Bill Stiggers, Dennis Fox and Roger Muenger were appointed to operate the Center, which is open Monday through Thursday during the school year from 3:30 to 6:30 PM. In October, 1987, Ken Fiore became the newsletter editor.

Related Programs

In February, 1988, a grant proposal submitted by the Cleveland Education Fund to the National Science Foundation to develop a Problem Solving Infusion Project was conditionally approved with a reduction in budget. A revised budget was returned to NSF, and notification arrived July 28 that the grant of $400,000, over four years, had been approved effective July 1. The Problem Solving Infusion Project is designed to unify several current programs, including the Mathematics and Technology Human Resources Enrichment Project (MATHREP), the Oberlin Problem-Solving Workshops, and the East Ohio Gas-sponsored Energy Problem-Solving Project. The project will focus on the seventh and eighth grades and will involve problem-solving activities, staff development, and a computer network.

The Cleveland Public Schools' Scholarship in Escrow program is one of two programs that evolved from a partnership between the school district and the Greater Cleveland Roundtable. Beginning with the semester grades at the end of the 1987-88 school year, students in grades 7 through 12 will earn $40 per A, $20 per B and $10 per C in five academic areas: English, mathematics, social studies, foreign languages and science. These funds will remain in an escrow account until students graduate from a Cleveland Public School; at that point, the money may be used to fund further education at either a college or technical/vocational school.

The School-to-Work Transition program is designed for students who think they will choose to enter the job market after graduation. The program provides job-readiness training and part-time and summer work experience. Graduates who qualify will receive priority hiring status for entry-level jobs in participating Cleveland businesses. Currently operating in four high schools, the program will expand to all comprehensive high schools over the next four years.

Teacher Participation

A strong core of collaborative teachers has emerged during the past year, as demonstrated by the consistently high number of participants in collaborative events. In fact, nearly one-fourth of the district's secondary mathematics teachers attended four or more collaborative activities during the year. Despite this development, there was some decrease in the total number of teachers who participated in collaborative events; the number of teachers who participated in at least one collaborative activity decreased from over 83 percent in 1986-87 to about 65 percent in 1987-88.

Robert Seitz, the on-site observer for the C^2ME, this year received the Presidential Award for Excellence in Mathematics Teaching. The award is given annually by the NSF to teachers demonstrating outstanding classroom performance, concern for students and professional development.

Science Collaborative

The Science Collaborative, like C^2ME, is funded through the Cleveland Education Fund and sponsors activities for science teachers. These have included a program for intermediate teachers supported by East Ohio Gas and a joint symposium at TRW for both the science and mathematics collaboratives.

D. Project Activities

During the 1987-88 school year, C^2ME sponsored an array of in-school, out-of-school, and networking activities to provide teachers with resources and opportunities that encourage professional growth. In addition to the activities offered by the collaborative, C^2ME encouraged, and in several instances financially supported, teachers' participation in a variety of local and national institutes, seminars, workshops and conferences.

Dinner Symposia

Nordson Symposium

The Nordson Corporation hosted sixty-one teachers and C^2ME Advisory Board members at its Amherst facility on Thursday, November 5, 1987. While the event initially was planned exclusively for Cleveland teachers, Nordson President William P. Madar, who is chairman of The Cleveland Education Fund Board of Trustees, was so enthusiastic about the symposium and Cleveland teachers' contributions to its organization that he invited several teachers from Amherst, Oberlin, and Westlake, where Nordson also maintains facilities.

Following a machine shop and assembly area tour conducted by Nordson employees, dinner was served at the train depot. Following dinner, Dr. Richard Klein, vice president of Corporate Research and Technology, spoke on the importance of mathematics education in today's business world. Nordson engineers produced a booklet of mathematics problems related to each station of the tour. The booklet was then reviewed by teachers before it was produced. Although each participant received a booklet, the number of requests for extra copies warranted a second printing.

The teachers were very appreciative of Nordson's efforts to make the symposium a success. One teacher said, "I come from business and I was never treated as nicely as we [the teachers] were treated. It really makes us feel like professionals to be treated this well." Several Cleveland teachers also commented that they enjoyed the opportunity to get together with teachers from other school districts.

Progressive Symposium

On March 10, 1988, the Progressive Corporation, a national insurance company, sponsored a symposium which was attended by sixty-five teachers, business and university representatives, and C^2ME Advisory Board members.

The symposium opened with a reception and welcome by Progressive Corporation President Peter B. Lewis, followed by a presentation on the company's extensive art collection. Of particular interest to teachers were several geometric works designed by an artist using a computer. Two Progressive executives then spoke on the "Mathematics of Insurance," presentations which had been planned jointly by two Cleveland teachers and two Progressive employees. At the "wrap-up" session after dinner, each participant received a booklet of problems. The evening concluded with an announcement that the Progressive Corporation would sponsor two summer internships for teachers.

One teacher commented, "The book was very useful. It is a good change in the structure of the symposia to give away books. I liked the chance to listen to mathematicians from business. I was impressed that they made us aware of entry-level jobs available to the public and the process of advancement in some of the jobs. We could definitely see the importance of math in the insurance business." A university professor who attended said, "Very informative. The application problems were good, the dinner was good, and the collegiality was excellent."

While the participants seemed to feel that the symposium was generally enjoyable and worthwhile, some teachers commented that the application problems were inappropriate for use in their classrooms and suggested that greater teacher input in creating the problems would have been useful.

End-of-Year Dinner

On June 9, 1988, the collaborative sponsored the second annual end-of-year dinner meeting at the Hilton South Hotel. More than ninety teachers attended the event, at which professors Frank Demana and Alan Osborne of Ohio State University and several teachers discussed a calculator project being implemented in the intermediate schools. Dinner followed the discussion. Intermediate teachers who participated in the project made the presentations.

Participants reported that the event was very successful. Many commented that they appreciated the opportunity to find out what was happening in the intermediate schools. Some of the high school teachers expressed the view that high school mathematics must continue and expand upon students' calculator use as a means of fostering new skills and reinforcing those mastered in the earlier grades.

Cleveland Mathematics Teachers Resource Center

The Cleveland Mathematics Teachers Resource Center was established at the Metro Campus of Cuyahoga Community College in October, 1985, as a clearinghouse for information and a meeting place for Cleveland Public School teachers. During the summer of 1987, the resource center moved from the third to the fourth floor of its campus site in order to expand its quarters. The Center, which is open from 3:30 p.m. to 6:30 p.m. Monday through Thursday, is staffed by three Cleveland Public School mathematics teachers. In general, the positions have been staffed by teachers who have had the time and interest to work at the Center, but in April, 1987, the Cleveland Education Fund appointed Bill Stiggers, Dennis Fox and Roger Muenger as permanent staff.

The Center provides Cleveland Public Schools mathematics teachers with opportunities for training and collegiality, and for access to information designed to enhance their knowledge and teaching expertise. The Center also serves as the hub of the district's curriculum development and in-service training, as well as a center for the collection, review, and distribution of materials. It provides consultation services and distributes a list of recommended materials to each department chair in order to encourage mathematics departments to obtain supplemental textbooks, supplies, and materials, including calculators to help teachers implement an activities-based approach to mathematics instruction. The Center also publishes a calendar of C^2ME activities and relevant information about other mathematics events sponsored by higher education, business, and industry, which it distributes to all secondary school mathematics teachers in the Cleveland Public Schools. The Center, equipped with a computer, laser printer and graphics software, produces the calendar and other flyers in-house. It also maintains a data base of teacher participation in C^{2}ME activities, teachers' addresses, and demographic information.

The Resource Center offered several programs and workshops during the 1987-88 school year. One example is "The Computerized Gradebook," a hands-on session for teachers held on January 13, 1988, which was attended by fifteen teachers. The Center also was the site of a variety of meetings, including those of the Test Construction, Curriculum Writing, and Math Competency committees, several mathematics departments, and the Teacher Advisory Board. Because the Center provides these committees with free access to the hardware and software needed for test construction, it is believed that its existence facilitated the development of the district-wide standards for high school mathematics in the Cleveland Public Schools.

During the 1987-88 school year, the Center joined Free-Net, a computer bulletin board system. "Schoolhouse," the Center's menu on the system, provides users with several areas to explore, including the Math Problem of the Week, a Calendar of Events and an Information Booth. The three district high schools with modems are connected to the system, and teachers and students use the network to transmit messages and to solicit information. The Center also added a telephone answering machine to ensure that calls are returned promptly. The telephone lines, like the Center site, are donated by Cuyahoga Community College.

During the first two years of its operation, the level of teacher participation in the Center has increased dramatically. Between the Center's opening on October 1, 1985, and December, 1985, eighty-five teachers availed themselves of its resources. During the same three-month period in 1986, teachers visited the Center 243 times. By the end of June, 1987, the number of visits, most of which were made by teachers, had increased to 473. During the 1987-88 school year, however, teachers made only 300 visits to the Center.

Math Clubs and Competitions

Aetna Math Clubs

In response to a proposal submitted in the summer of 1987, C^{2}ME received a grant of $23,000 from the Aetna Foundation to help fund mathematics clubs in each of the Cleveland intermediate and high schools during the 1987-88 school year. Funds of up to $400 were offered to each school to encourage the formation of new mathematics clubs and to support the mathematics activities of existing clubs.

The goals of the Aetna Math Clubs are:

1. to support and invigorate mathematics clubs and increase the number of clubs in the Cleveland Public Schools;
2. to create and promote enthusiasm for mathematics among teachers and students;
3. to communicate to students high expectations for their mathematics achievement;
4. to provide opportunities for teachers to test new instructional methods;
5. to provide activities to foster networking among teachers, among students, and between teachers and students;
6. to increase participation in mathematics contests;
7. to encourage teachers and minorities to become involved in the mathematics club;
8. and, ultimately, to foster an environment that will encourage student achievement.

During 1986-87, ten math clubs existed in the district's secondary schools. During 1987-88, thirty-three of the district's forty-two secondary schools established clubs. Many of the clubs' efforts focused on developing problem-solving skills. Other club activities included preparing students for contests, providing information about careers, providing materials and supplies for creating models, and tutoring.

Because the Aetna Math Club Program places a high value on mathematics contests, grants to schools were contingent upon a commitment to participate in at least two major mathematics competitions during the school year. As a result, Cleveland Public Schools experienced an increased rate of participation in mathematics contests, including those sponsored by the Ohio Mathematics League, the Greater Cleveland Council of Teachers of Mathematics, MATHCOUNTS, the American Junior High School Mathematics Examination, the American High School Mathematics Examination, the Ohio Council of Teachers of Mathematics Examination, and the Mathematics Triathlon and Elementary Math Competition at Cleveland State University.

The collaboratives sponsored two meetings for mathematics club advisors during the

1987-88 school year. On November 10, 1987, a reception was held to discuss math club activities, to distribute a variety of materials that advisors could use with their mathematics clubs, and to answer any questions that the advisors may have had. The get-together provided an opportunity for experienced mathematics club advisors to share their knowledge and perspectives.

A second meeting was scheduled April 19, 1988, to enable mathematics club advisors to discuss their clubs' successes and failures during the year. While many teachers expressed real enthusiasm about their clubs, one teacher was concerned about the requirement that mathematics clubs participate in a minimum of two contests. She indicated that her students were not ready for the competition and felt demoralized about their performance. Another teacher spoke in support of the requirement: "The students need the exposure so they can compete in the real world with other students." The April meeting was a success. One product of the meeting was a list of successful mathematics club activities, which will be compiled and distributed to all mathematics club advisors.

C^2ME Algebra and Geometry Competitions

On Saturday, May 14, 1988, C^2ME sponsored the Second Annual Algebra Competition and First Annual Geometry Competition at John Carroll University. The contests were designed to help students improve their mathematics skills and to demonstrate that doing mathematics is a worthwhile and enjoyable activity. The competitions were limited to the Cleveland Public Schools. Each school was invited to enter one or more teams of four students in either or both contests. Nineteen teams from twelve schools participated in the algebra contest, for a total of seventy-six students; seventeen teams from fifteen schools, a total of sixty-eight students, participated in the geometry contest.

The event was a huge success. Coaches felt that participating in the contest was a beneficial and exciting experience for their students, and, as one coach said, "The students had a great time." It is anticipated that next year the event will be expanded to include an advanced mathematics competition.

The Mathematics and Technology Human Resources Enrichment Project (MATHREP) and MATHCAMP

In April, 1987, the Ohio Board of Regents granted $41,000 jointly to The Cleveland Collaborative for Mathematics Education, Baldwin-Wallace College, and the Cleveland Public Schools to fund the Mathematics and Technology Human Resources Enrichment Project (MATHREP), which addresses the under-preparedness of mathematics teachers in the intermediate schools. The funds are to be used for stipends, manipulatives, and books.

Phase I of the project, a three-week MATHREP workshop, began June 16, 1987. Fifteen of the twenty-three participants were teachers from the Cleveland Public Schools. Among workshop highlights were presentations by ten guest speakers, ranging from Ohio recipients of the Presidential Award for Excellence in Teaching Mathematics, to authors and IBM education specialists. Richard Little, professor of mathematics and computer science, taught one session each day on number theory, calculators, and classroom procedures. Participants attended the Paul Klee exhibit at the Cleveland Museum of Art. Klee taught mathematics at the Bauhaus and used geometry extensively in many of his paintings and sketches. Tours of the NASA Lewis Research Center and the computer center at Cedar Point Amusement Park also were included in the workshop.

Twenty of the twenty-three Phase I participants re-enrolled for Phase II, which was scheduled over seven Saturday mornings and two Saturday afternoons between September 12, 1987 and January 30, 1988. Participation in two meetings of the Greater Cleveland Council of Teachers of Mathematics also was included. Each teacher participant created a project to be used as one week's lesson plans in his/her class. Four of these projects were presented on March 18, 1988, at the Ohio Council of Teachers of Mathematics statewide meeting.

Evaluations of both phases of the MATHREP Program were positive. One teacher's view that "the materials from the workshop were ones I could take back to the classroom and use" seemed to reflect the general consensus of the participants.

In Phase III, which is planned for late July or early August, 1988, Phase II participants will nominate several of their best students to attend a one-week Summer MATHCAMP to be held on the Baldwin-Wallace College Campus. The nominees will visit Baldwin Wallace in May for a competitive exam. The highest scoring nominee of each Phase II teacher will be invited to MATHCAMP. The twenty nominees who have the next highest scores on the test also will be invited to participate. The sixty MATHCAMP participants will devote an entire week, from Sunday evening through Saturday afternoon, to mathematics. They will be divided into three groups, and each group will be involved in three distinct activity-based mathematics classes each day: Number Theory with calculators, Geometry with measurement activities and computational problem solving, and Computer Software (the Geometric Pre-Supposer).

Institutes, Seminars, and Workshops

North Carolina School of Science and Mathematics (NCSSM) Workshop

The Mathematics Department at North Carolina School of Science and Mathematics (NCSSM), working with a grant from NSF, is developing a syllabus for fourth-year college preparatory mathematics. The syllabus is commonly viewed as representative of future trends in mathematics education. NSF has funded a teacher-training model in which teachers take a leadership role in instructing others in the use of the new syllabus.

Three members of the mathematics faculty of the Cleveland School of Science attended the training session, "An Introduction to College Mathematics," in North Carolina from July 5-17, 1987. Topics included geometric probability, functions, exponential and logarithmic functions, trigonometry functions, matrices, statistics, modeling and data analysis. Presentations emphasized the use of software to provide students with experiences in applied mathematics that usually would be inaccessible to them. Problem-solving strategies were suggested as a means of enlivening necessary manipulative aspects of the traditional fourth-year course. Course materials assumed that an instructor would have one computer (512K) and one large monitor to use with a class.

One workshop activity required teachers to make presentations to both large and small groups in preparation for the in-service in this method of class interactive presentation that they would give to teachers in their home districts.

During the 1987-88 school year, the three Cleveland teachers who participated in the summer training session pilot-tested the materials with their classes. They acquired a Small Grant from the Cleveland Education Fund to purchase a machine upgrade and large monitor to facilitate this activity, and also gave copies of some of the disks and

NCSSM text material on Data Analysis, Geometric Probability, Matrices, and Functions to the Resource Center.

In May, 1988, their NCSSM instructor visited the three teachers to observe their classes and to help them plan a workshop that they will conduct for Cleveland Public School teachers during the summer of 1988.

Oberlin Teachers Academy

The Oberlin Teachers Academy provides opportunities for school teachers and administrators to study at Oberlin in disciplines commonly included in the high school curriculum. Funded in part by a grant from the Cleveland Foundation and district ESFEA Chapter 2 funds, the Academy offers summer institutes as well as in-service education through seminars and workshops held during weekend retreats throughout the school year. The retreats started at 5:00 Friday afternoon with a social hour, and concluded at 3:00 on Saturday afternoon. Eight mathematics teachers participated. Because teachers were drawn from other content areas as well as from mathematics, the number of participating mathematics teachers was reduced from previous years.

The majority of Oberlin's programs are geared toward secondary school teachers and administrators, and many were directly related to mathematics. The collaborative promoted several of the workshops, and Cleveland Foundation scholarships were available.

New perspectives in Geometry: Parts I and II. This two-part workshop was designed for geometry teachers and high school mathematics department chairpersons. The first session, which was held November 6-7, focused on: (1) the Van Hiele model of the development of geometric thought; (2) some "real world" uses of geometry; and (3) development of a set of non-routine geometry problems that can be used in the typical high school course. The second session, held December 4-5, concentrated on: (1) developing students' spatial perceptions; (2) geometry as an aid to understanding other branches of mathematics and (3) the kinds of geometric experiences students should have before entering high school. Dr. Crawford taught both sessions. Money from the Cleveland Education Fund and ESFEA was used to pay the registration fee of $100 for the five teachers who attended.

Women in Mathematics. This seminar provided a review and analysis of the contributions of women to the discipline of mathematics. Current data on female enrollment in high school, college and graduate school programs also was presented. Gloria A. White, a lecturer at Oberlin College, led the seminar, which was held November 20-21. One C^{2}ME teacher participated.

School-based Mathematics Leadership. This workshop, held February 19-20, focused on several high school programs that have achieved excellence in mathematics education. The workshop, led by Dr. Crawford, also featured an Ohio study committee's recent work on school-based leadership. Four C^{2}ME teachers received scholarships to attend.

Discrete Mathematics. At this workshop, held February 26-27, several topics from the area of discrete mathematics were presented, including graph theory, combinatorics, finite probability and set theory. Dr. Christopher Leary, Assistant Professor of Mathematics, led the workshop. Two C^{2}ME teachers received scholarships to attend.

Issues in the Secondary Mathematics Curriculum. Directed at math department chairpersons as well as high school mathematics teachers, this workshop, held March 25-26, addressed issues that concern department chairpersons as they implement their programs. On the registration form, each registrant was encouraged to submit topics for discussion. Topics covered included course offerings for discrete mathematics, and probability and statistics. Two C^{2}ME teachers participated in the workshop, which was led by Dr. Crawford.

Summer Institute on Problem Solving. During the summer of 1987, Dr. Rudd Crawford instructed a two-week institute on problem solving for Cleveland area teachers. Three mathematics teachers from the Cleveland Public Schools were among the fifteen participants. The sessions were sponsored jointly by Oberlin and CPS; CPS and the Cleveland Education Fund granted tuition scholarships and Oberlin provided the instructors and the facilities. The project was intended as a pilot for the collaborative's NSF Problem-Solving program. The set of thirty problems was duplicated and distributed to interested teachers in the district. Following the completion of the institute, the three teachers spent an additional week working with Dr. Crawford to write and refine a set of problems. Each of the teachers received a stipend for the week, paid for by the district.

Professional Conferences

Ohio Council of Teachers of Mathematics (OCTM) Annual Meeting

C^2ME offered to fund up to forty Cleveland secondary mathematics teachers to attend the OCTM Annual Meeting in Youngstown, Ohio, on March 18-19, 1988. Twenty-six CPS teachers took advantage of the offer and C^2ME paid for round-trip transportation, registration fees, continental breakfasts, lunch, hospitality suites, tickets for the Friday night banquet (with keynote speaker Bob Kansky of Texas A&M, who wrote "The Principle of Mathematical Seduction"), and hotel accommodations on Friday night. Substitutes were provided by CPS.

The degree of participation was considered excellent as a teachers' strike during the registration period discouraged many potential participants from planning to attend. (Some teachers had been misinformed that participation in the meeting would constitute a strike violation.)

Six of the C^2ME participants were presenters at OCTM: CPS mathematics supervisor William Bauer; Oberlin College faculty member Dr. Rudd Crawford; Baldwin-Wallace faculty member Dr. Richard Little; and three C^2ME teachers.

Those who attended the conference found it very worthwhile. For several of the teachers, it was their first experience at a mathematics conference. Many expressed the opinion that they would like to attend again and that they were exposed to many good ideas to take back to their classrooms. The teachers also expressed pleasure that the school system provided release time and substitutes for this type of activity.

One CPS teacher said, "To grow professionally, it is of tremendous value to be exposed to those methods and ideas that have worked successfully for our colleagues, both nationally and statewide." Another said, "It was good being able to meet with other classroom teachers and bring back materials." Conference participants were invited to attend a "debriefing" session at the Cleveland Education Fund office preceding a Teachers Advisory Board meeting.

National Council of Teachers of Mathematics (NCTM) Annual Meeting

C^2ME paid expenses for nine teachers to attend the annual meeting of NCTM April 6-9, 1988, in Chicago, Illinois. Two additional collaborative personnel, Math Supervisor

Bill Bauer and On-Site Observer Bob Seitz, also attended the conference. The collaborative offered to sponsor the attendance of ten teachers; nine applied. Given that, because of the teachers' strike, school was in session during the conference dates, the teachers felt very fortunate that the school district permitted them to attend the meeting. Permission was obtained through intervention by the collaborative.

All nine teachers were very enthusiastic about the conference and indicated that they would like to attend another national meeting. Some teachers wrote small grants based on what they experienced at the meeting. One of the attendees wrote an article for the C^2ME newsletter in which she said, "It was an exciting four days spent in Chicago, where I was one of the more than 8,000 mathematics educators present. It was exciting to meet in person several people whose contributions to mathematics education I had seen only in print. The fifteen sessions I attended had a message to all mathematics educators. Thanks to the generous support of C^2ME, I was able to grow professionally and return with many new teaching ideas."

National Conference on Mathematics Reform and Teacher Professionalism

One C^2ME teacher was selected to attend the Mathematics Reform and Teacher Professionalism conference at the North Carolina School of Science and Mathematics in Durham, North Carolina, on June 23-24. The new coordinator also attended. The conference was designed to inform and guide the broader mathematics community in its effort to improve mathematics education at the pre-college level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. The conference focused on helping educators to understand the need for change in mathematics education and developing strategies for bringing about that change.

Teacher Internship Program

Cleveland's Teacher Internship Program (CTIP) was established in 1980 to offer teachers hands-on experience with the mathematics used daily in business and industry. The program establishes and coordinates summer work placements for teachers in area businesses and industrial labs.

During the summer of 1987, fifteen CPS teachers were selected by five corporations to serve as interns. Of the fifteen, seven are mathematics teachers; six of the positions were full-time and one was part-time. The internships ranged from seven to ten weeks, with an average salary for the full-time positions of $4,750.

In addition to working at the corporation, teachers attended six afternoon seminars over the course of the summer and prepared a new learning project for their own classrooms. Teacher interns also enrolled for one to seven graduate credits at CSU in conjunction with these projects. Interns met in October to share their completed work.

Twenty-two CPS teachers have been selected to serve as 1988 summer interns through Cleveland's Teacher Internship Program. Of these, eight are intermediate and secondary mathematics teachers. As in previous years, there were a few more applicants than positions.

Small Grants Program

The Cleveland Education Fund's Small Grants Program is intended to help teachers, principals, parents and/or students develop creative projects that address high priority educational goals, increase student motivation to learn, and lead to improvements in the educational process. By providing seed money for instructional experimentation, the Fund supports innovative efforts that enrich and strengthen the curriculum. Only projects with educational content are considered. The maximum amount for a grant is $500. The three deadlines for submitting requests were October 1, 1987; January 15, 1988; and April 25, 1988. Grants awarded for mathematics-related projects on the intermediate and high school levels increased from ten in 1986-87 to twenty-two in 1987-88.

Elementary, intermediate and secondary schools participate in the program, and grants are awarded in every subject area. Grants total almost $50,000 each year; individual awards average about $440.

Teacher Scholarships

As part of its commitment to C^{2}ME, the Department of Mathematics at John Carroll University continued to offer tuition scholarships to mathematics teachers in the Cleveland Public Schools. Scholarships cover tuition for university mathematics courses, ranging from introductory calculus and statistics to graduate courses in the department's Master of Arts and Master of Science programs. A full scholarship, awarded on a competitive basis by a department committee, was granted to one mathematics teacher for 6 credits of work in the Master of Science Program for the summer of 1987.

C^2ME Newsletter

The collaborative's quarterly newsletter was distributed to teachers and Advisory Board members throughout the 1987-88 school year. The newsletter announces events, programs and contests; recognizes teachers for personal accomplishments and C^2ME participation; and prints articles of interest to mathematics teachers.

In fall, 1987, the original editor of the collaborative newsletter resigned due to time constraints after having edited the newsletter for two years. The new editor is Ken Fiore, a mathematics teacher at the Cleveland School of Science.

E. Observations

The Cleveland Collaborative for Mathematics Education experienced a smooth transition in its management staff during the year. The high level of collaborative activities continued as a result of the active involvement of the Advisory Board and Teacher Advisory Board.

Project Management

From its inception, a strength of the Cleveland Collaborative for Mathematics Education had been its leadership, provided primarily by Project Director Paula C. Fay. It became apparent when Ms. Fay left in the fall, however, that the strength of the collaborative is embedded in its organizational structure rather than in the particular personalities of its leaders. A strong program was maintained throughout the year, a permanence proposal was prepared, and new activities were generated although the Education Fund was without a director for four months and the collaborative did not have a full-time coordinator for three months at the end of the school year.

An essential element of the collaborative's organizational structure is its Advisory Board, which meets regularly and has maintained a consistent membership. The Board's meeting agendas have included reports from all sectors--schools, business and industry, and higher education. Prior to each meeting, six to nine Board members are assigned responsibility for specific agenda items. Their reports, in combination with ongoing discussions on such issues as the budget, future directions, public relations, and strategic planning, have made each meeting both full and productive.

Another factor important to the success of the collaborative during the year is the commitment of the people who play active roles in its organization. Coordinator Suzanne Haggerty worked long hours during the interim period between directors to ensure a smooth transition. Joe Flynn provided support and assumed responsibility for a variety of tasks. Bill Madar, chairman of the Education Fund Board, contributed his time whenever possible. Bill Bauer, mathematics supervisor, met regularly with the collaborative coordinator and continued to generate ideas that could be pursued in the area of mathematics. Barbara Patterson, as the new Education Fund Director, came to the position with strong qualifications and began immediately to address several collaborative issues, including hiring a new coordinator and preparing the permanence proposal.

The Teacher Advisory Board assumed more responsibility during the year and contributed to the planning process. In previous years, the TAB had met once in the fall and had not played any specific role beyond providing reactions to plans developed by the Advisory Board and suggestions on possible collaborative activities. Last year's documentation report noted that some teachers had commented that the Education Fund was perceived as the primary decision maker for the collaborative. In response to this misperception, the collaborative leadership increased the number of teachers on the TAB, increased the number of TAB meetings during the year, and encouraged the group to set its own agenda. During the spring, for example, the TAB organized and hosted a meeting of all of the teachers who sponsored a mathematics club; Bill Bauer assumed responsibility for finding a meeting place and for notifying teachers of the event. Thus, the involvement of the TAB increased greatly during the school year. It is yet to be seen how collaborative teachers will react to this peer group and whether it will be viewed as an entrance into the collaborative's decision-making process.

Collaboration

A high level of collaboration has been achieved by the members of the C^2ME Advisory Board. Its activities and networking are clear examples of the positive, productive interaction that can occur among people from the schools, business, industry, and higher education. This interaction has produced a wide range of benefits in addition to specific collaborative activities. The past year, for example, has brought enhanced status to mathematics education and to the mathematics supervisor in the district. The chairman of the Advisory Board, a businesswoman, wrote a letter to the district superintendent complimenting the efforts of the mathematics supervisor. Business backing is important to Cleveland Public Schools, particularly in light of such new initiatives as the Scholarship in Escrow Program. Thus, the district administration's perception that the mathematics supervisor is well connected with local businesses may serve to enhance his status and influence in the district's decision-making process. This, among other collaborative efforts, may have contributed to the superintendent's increased interest in the mathematics program over the past year. That interest was evident in the district's decision to provide most of the funds to purchase calculators for students and teachers in a junior high school calculator project, and in the district's willingness to pay for the telephone lines teachers needed in order to have access to the computer bulletin board. Another Advisory Board spinoff involves a bank executive who heard at a board meeting about an Ohio State University calculator project and convinced his bank to contribute funds to the project. In ways such as these, the collaborative's active and productive Advisory Board is generating a climate that is supportive of mathematics activities beyond the actual activities of the collaborative.

The C^2ME has been able to provide teachers with opportunities to interact with representatives of business and higher education in a variety of ways. Dinner symposia are planned by a committee comprised of teachers and employees of the sponsoring business to ensure the event is relevant to teachers. One common outcome of this interaction is that the businesses present the teachers with a booklet of mathematical applications addressed in their workplace. The mathematics contests are planned and the contest materials written with the involvement of a group of teachers and the faculty from John Carroll. Mathematics teachers have had greater opportunity to participate in pilot projects, such as the calculator projects of The Ohio State University, which involve cooperative interaction between the teachers and the university professors.

Teachers' interactions with mathematicians in business and higher education are beginning to impact on their classroom approaches. Asked about the effect the collaborative has had on daily teaching, a teacher responded that, "Contacts in industry have been helpful. Students have new opportunities through these contacts, jobs, etc." Another teacher, responding to a question about the changes in his/her view of the mathematics curriculum, said, "How much math is required for certain occupations is very important and the collaborative has opened my eyes to this application of mathematics." This teacher also noted that the exposure to university professors is valuable.

Within the core of forty-five teachers who are frequent participants in collaborative activities, several have assumed various leadership roles. Three teachers operate the Teacher Resource Center. Another edits the newsletter. While these teachers are paid only token amounts for filling these positions, they enjoy the opportunity to present workshops and to serve as resources to other teachers.

Finally, as in other collaboratives, teachers appreciate the collegiality that has resulted from the opportunity to interact with teachers from other schools. Some teachers were asked about the most significant changes that can be attributed to the collaborative. One teacher noted the "new communication, inter-school and intra-school." Another teacher cited the new friendships with teachers from other schools. A third teacher observed that the collaborative provides a common meeting place where teachers can talk to teachers.

Professionalism

During the 1987-88 school year, indications were in greater evidence that mathematics teachers are increasing their sense of professionalism, a pattern that is common as the collaboratives have evolved. While engaged in a teachers' strike with the district, twenty-six mathematics teachers registered to attend the Ohio Council of Mathematics Teachers conference. In a situation in which teachers were insisting that the district reconsider increased working hours, and in which many teachers were expressing their anger and frustration with the district, these mathematics teachers remained interested in professional development. Given that some teachers had been misinformed that attendance at the meeting would constitute a strike violation, the turnout was remarkable. In addition, the district granted eight teachers release time to attend the NCTM annual meeting in Chicago even though all such days had been disallowed because of the strike. This willingness to compromise suggests a positive relationship between the district, the collaborative, and the teachers who are involved.

Mathematics teachers also report that they have been involved in more enrichment activities during the past year. Some teachers are working with student mathematics clubs and on mathematics contests. Others sit on central committees, writing tests and planning curriculum. Still others attend the institutes and other professional development activities, such as the Oberlin Teachers Academy. As one teacher commented, the most significant change that could be attributed to the collaborative is "getting me involved in collaborative activities." This teacher went on to say, "I wouldn't have done any of the things I did if it weren't for the collaborative."

Mathematics Focus

C^2ME's mathematics emphases have been placed on problem solving, using calculators in the teaching of mathematics, and applications. Problem solving is the focus of such activities as the summer institutes, the grant proposal sent to NSF, the use of the computer bulletin board operated by the Resource Center, and problem booklets provided at the dinner symposiums. It is clear that this emphasis on problem solving is having some effect. One teacher reported, "My base of knowledge has been broadened by activities, it has improved my way of approaching problem solving, improved my math skills, and made me more aware of the applications around."

Participation in the district's calculator projects and access to computers at the Resource Center are two opportunities that have significantly influenced some teachers. One teacher who attended a session on calculators at the NCTM annual meeting observed that the presentation was really outdated when compared to what was going on in Cleveland schools. Important to the calculator project is that the tool is not just used as a means to compute, but as a means to understand mathematics better by generating a number of examples of a concept or by producing different values for a function. One teacher reported that the most significant change attributed to the collaborative was increased calculator use in the classroom and the effect that the calculator use had on his daily teaching. Another teacher reported that, as a result of the collaborative, he/she had access to a large amount of computer time and broad exposure to different software. Thus, it appears that the collaborative's emphasis on involving teachers with technology has been a successful approach.

Another important emphasis of the collaborative has been to bring together teachers and those from industry to help increase teachers' awareness of how mathematics is being used in the workplace. This involvement has confirmed for at least one teacher that "mathematics is alive and doing well." Another teacher commented, "I am able to better give examples of where these concepts are used in everyday life. I am more aware of what concepts are important for the students to learn." Teachers' increased knowledge of applications has influenced their approach to their students. One teacher reported, referring to her students, "Some individuals have been affected, especially if I can relate it to (the students') interest. Showing them where mathematics can be used arouses their curiosity."

The collaborative's mathematics focus is embedded in that of the district. One reason for this close interaction has been the mathematics supervisor's active involvement in the collaborative. In many cases, the cooperative relationship between the district and the collaborative has made it difficult to discern which events or developments can be attributed to the collaborative and which have occurred as a result of other factors. It is clear, in any case, that change is happening.

F. Next Steps

Cleveland plans to continue out-of-school, in-school and networking activities that have proved successful; to add new activities in support of the four-year plan; and to augment its public relations efforts by expanding its symposia invitations and newsletter distribution lists, as well as developing a brochure and videotape and holding a community seminar on careers using mathematics.

The Cleveland Collaborative for Mathematics Education plans to administer the approved National Science Foundation grant to develop and implement a model to incorporate problem solving into the Cleveland Public Schools' seventh- and eighth-grade mathematics curriculum. The model, the Problem Solving Infusion Project, will produce and test a set of teacher-developed problems, and assist teachers in using them through development of a presentation format (template) and a community computer network.

Cleveland's calculator program will continue, and additional seventh- and eighth-grade teachers will be trained to address numeric problem solving using scientific calculators. Cleveland twelfth graders will be involved in a pilot of the Calculator and Computer Pre-Calculus project, which will use calculators.

Oberlin College, with a grant from the General Electric Foundation, is inaugurating an ongoing Project to Increase Mastery in Mathematics (PIMM) for secondary mathematics teachers. PIMM Fellows will study statistics, discrete mathematics, computer modeling, the mathematics education reform movement and mathematics leadership issues. Teachers Academy weekend workshops also will be held during the school year at Oberlin.

Cleveland plans to continue to support teachers' attendance at the Andover-Dartmouth Urban Teachers Institute, Charleston Naval Base Educators Conference, North Carolina School of Science and Math Conference, and the Phillips Exeter conference. The Teacher Internship Program plans to provide summer placement for eight mathematics teachers in 1988 and to increase that number by one or two teachers every year thereafter.

Cleveland plans to continue to sponsor teachers to attend the most popular professional meetings; about forty teachers will receive grants to attend OCTM, and ten to attend NCTM. During 1988-89, the Cleveland Education Fund will initiate a School Team Enrichment Project (STEP) that will provide grants, up to a maximum of $1200 to a team of teachers and administrators within a school. About $10,000 will be earmarked for Small Grants and STEP grants during 1988-89 to encourage teacher innovation and creativity.

EQUALS, a program to attract and retain women, minority and "at-risk" mathematics students, and SEQUALS, for those who have completed the EQUALS program, will continue. Mathematics contests also will continue, with promised funding from Aetna, contingent upon each club's participation in two major mathematics contests during the school year. Most teams participate in more than two contests.

The Math Teachers Resource Center will continue to function as a clearinghouse and meeting place for departments, and for test construction, curriculum writing and contest planning committees. Staff will continue to publish the monthly calendar and to monitor the bulletin board.

Networking will continue, with two or three symposia to be offered each year. In addition, a joint math/science collaborative symposia on the integration of critical thinking skills into the math and science curricula has been funded. The C^2ME newsletter will be published four times each year. Cleveland teachers also are working with East Ohio Gas Company in writing energy-related lessons to be distributed to Cleveland Public School teachers, as well as those throughout northeastern Ohio.

Energy Problem-Solving Project

The Cleveland Collaborative for Mathematics Education has received $16,000 from the East Ohio Gas Company's CNG Foundation to fund the Energy Problem-Solving Project. The proposal had been jointly submitted with the Science Collaborative, as part of C^{2}ME's effort to promote the teaching of problem solving and to update the consumer mathematics curriculum which will be followed in 1988-89.

The project will: 1) plan and conduct a dinner symposium for mathematics teachers to provide a first-hand look at problem-solving applications and to convey the integral relationship of energy, problem solving and mathematics; 2) develop a format for the presentation of problem-solving activities that will aid teachers in the development of their own problems and in the incorporation of problem solving into classroom instruction; 3) develop and test energy-related problems correlated to course objectives; and 4) produce a notebook containing these problems to be used in Cleveland and in school districts throughout the northeastern Ohio region.

SUMMARY REPORT:
DURHAM COLLABORATIVE: THE DURHAM MATHEMATICS COUNCIL

by the

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Durham Mathematics Council for the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Durham Mathematics Council to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting in San Diego in February, 1988; meetings held during the annual NCTM Conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

DURHAM COLLABORATIVE: THE DURHAM MATHEMATICS COUNCIL

A. Purpose

The activities of the collaborative continue to be guided by the five interrelated themes outlined in the proposal for refunding in 1986. These themes are:

1. The empowerment of teachers to determine the mathematics curriculum. The state of mathematics is changing rapidly, with a new emphasis on such topics as finite mathematics, statistics, and microcomputer applications. As technology continues to advance, the need to update the mathematics curriculum becomes more pressing. By encouraging and supporting mathematics teachers in their development of new curricula and methodologies, and by providing teachers with opportunities for professional growth and leadership, the Council will empower teachers to play an influential role in the process of changing the curriculum. By uniting teachers in a cooperative effort, the Council will help them develop a stronger voice in future curriculum matters.

2. Involvement of teachers in decision making. Too often in the past, teachers have been passive agents in curriculum reform. Rather than partners in the process of change, teachers have been the recipients of change. If teachers are to become true professionals who impact on such key matters as curriculum, they must become involved in the decision-making process. Community recognition of teachers as experts in their field is a necessary condition for such involvement.

In light of this, the Council will develop activities to aid teachers in acquiring the expertise and leadership potential necessary to foster their participation in the decision-making process. The Council will concentrate on developing high visibility and support from all areas of the community.

3. Council expansion to serve teachers throughout the Research Triangle area. The Research Triangle area (Durham, Raleigh, Chapel Hill) is rich in resources and in mathematicians. Expansion of Council programs to involve teachers throughout this area will increase Council visibility and status. This growth can be expected to enhance teachers' abilities to make change happen.

4. Impacting on curriculum at the state level. An increasing number of basic curriculum matters are being decided at the state level. If the Council is to empower teachers to affect change and to set the course of mathematics education, it must expand its focus to include the state level as well. The Council must assist teachers in their efforts to become involved in state decision-making processes regarding such issues as curriculum, statewide testing, and textbook selection.

5. Development of a professional mathematics community. The Council's highest priority involves easing the feelings of isolation and powerlessness experienced by mathematics teachers. The Council will strive to develop a truly professional mathematics community in Durham, composed of mathematicians from all sectors. The Council will work to combat the negative stereotypes expressed in such phrases as "just a teacher . . ." as well as to develop a base of community support in order to demonstrate the value that Durham places on mathematics and education.

The goals implicit in these themes constitute a very ambitious undertaking. The Council has identified four areas in which it must succeed if the collaborative is to become institutionalized:

1. The development of a secure resource base. Over the next four years, the Council must develop strategies to secure a sound, stable financial base. If long-term goals are to be met, and if teachers are to be asked to make long-range commitments, then the Council must demonstrate its financial security.

2. The involvement of teachers in the decision-making process. Traditionally, teachers have not been involved in policy decisions. The Council must address the existing policy framework in order to develop strategies that will involve teachers in the decision-making process.

3. The development of a broad-based network. The Council must develop strategies to educate members of the mathematics community about ways they can and should work together. Traditionally, barriers have existed between people in the university, business, and public school communities. The Council must find ways to transcend these barriers and to demonstrate commonality of purpose among area mathematicians.

4. The establishment of ownership of the Durham Mathematics Council. The Council must strive to develop a sense of community ownership. In order to survive, the Council cannot be viewed as a Ford Foundation project, nor as a program of the North Carolina School of Science and Mathematics; it must be seen as a Durham project to improve education in Durham. If the anticipated geographic expansion does occur, then the project must be viewed as a program of the Research Triangle area. The Council will need to focus on strategies to develop this sense of community ownership.

DMC activities during the school year were directed towards establishing teachers as the agents for reform in the mathematics curriculum. Given this focus, the activities were planned to emphasize three broad, overlapping themes: professional growth and empowerment, curriculum reform, and networking.

B. Context

The city of Durham, which is situated in a metropolitan area of 160,000, has a population of approximately 105,000 persons. The city and county have separate governments and responsibilities, and the two school systems act somewhat independently of each other. The Durham Public Education Fund (DPEF) has been established to serve both the city and county schools and to foster a commitment to public education in the private sector. The A.J. Hetcher Foundation awarded a grant of $77,000 to the DPEF to pay the salary of an executive director.

The Durham community is served by the Durham City and Durham County Schools. The geographical districting of the two systems does not conform to city and county boundaries. Several county schools are located within the City of Durham.

The Durham County Schools consist of twenty-two schools, including five middle schools (grades 7-9) and three senior high schools (grades 10-12). Approximately 18,000 students attend county schools, of which 71 percent are white and 29 percent are black. Less than 1 percent of students in the district have English as a second language, and 14 percent are in federally funded lunch programs. Enrollment in the district is increasing, and the impact of private schools in the district is relatively minor.

Approximately 4,000 students attend county middle schools. Sixty-nine percent are white and 31 percent are black. Less than 1 percent have English as a second language, and 14 percent are eligible for government-funded lunch programs.

Four thousand students in the district attend senior high schools. Seventy-one percent are white and 29 percent are black. Less than 1 percent have English as a second language and 4 percent are in government-funded lunch programs. Currently, approximately 76 percent of Durham County Schools graduates go on to post-secondary education. The annual dropout rate is approximately 5.6 percent. Graduation requirements for county students currently include two units of mathematics, but that will be increased to three units beginning in 1992. Any student who meets all course requirements for graduation but fails to pass one of the four sections of the required competency test can receive a certificate in lieu of a diploma.

Approximately 80 percent of high school students in the county system were enrolled in mathematics courses for the 1986-87 school year. On average, students take more than three mathematics courses during their high school careers.

The Durham County Schools employs 320 high school teachers. Sixty-four percent are women and 36 percent are men. Eighty-two percent of high school teachers are white and 18 percent are black. Annual salaries range from $17,500 to $29,120, plus a local supplement. There is no teachers' union in the district, and teacher contract negotiations do not occur in the state of North Carolina. The current contract, which is renewed annually, expires in May, 1989.

In 1987-88, the Durham County high schools employed forty mathematics teachers. Seventy-three percent are women and 27 percent are men. Seventy-eight percent of high school mathematics teachers are white and 22 percent are black. Nine teachers hold a master's degree and thirty-two have a bachelor's degree. All of the high school mathematics teachers in Durham County are certified to teach mathematics, and 63 percent are tenured. Another forty-four teachers taught mathematics in middle schools.

At the end of the 1987-88 school year, Dr. Cleveland Hammonds, Superintendent of Durham City Schools, accepted a position as superintendent of schools in Birmingham, Alabama. Mr. Frank B. Weaver was appointed as the interim superintendent until the process of hiring another superintendent could be completed. Total expenditures for the district during 1986-87 were approximately $47 million, or $3,752 per pupil. Thirty-five percent of these expenditures was paid by local funds. A total of 8,464 K-12 students were enrolled in the district during 1987-88. A number of these, 64 percent, are eligible for the government-funded lunch program. The annual dropout rate for 1987-88 in Durham City high schools was 11.5 percent which was the highest in the state of North Carolina. Students in sixth grade scored, on the average, at the 32 percentile on the California Achievement Test (CAT). Eighth grade students had CAT scores, on the average, at the 35 percentile.

In 1987-88, Durham City Schools employed twenty-nine secondary mathematics teachers and twenty-six middle school mathematics teachers. Seventy-one percent of the city's mathematics teachers are female and 59 percent are minorities. No other information was available.

C. Development of the Collaborative

The Durham Mathematics Council operates out of the North Carolina School of Science and Mathematics, a state-funded residential high school for academically talented eleventh- and twelfth-grade students. The DMC's association with the North Carolina School of Science and Mathematics offered its members the opportunity to participate in a variety of special activities associated with the school's mathematics faculty, such as conferences that covered proposals for a course that would replace pre-calculus in the high school curriculum.

DMC leadership is provided by its director, Dr. Keith Brown, Dean of Special Programs and Research of the North Carolina School of Science and Mathematics, and its executive director, Dr. Jo Ann Lutz, a NCSSM mathematics teacher. During the 1987-88 school year, Dr. Lutz had a half-time appointment to direct the activities of the collaborative while maintaining a half-time teaching load and other responsibilities associated with her teaching. Dr. Lutz is assisted by a full-time secretary, Barbara Davis. Betty Peck, a mathematics teacher in the county schools, is the on-site observer. The DMC activities have involved the 139 area mathematics teachers, as well as more than twenty people from higher education and business.

As executive director of the DMC, Dr. Lutz is responsible for daily operations, including working with teachers to plan and implement all DMC activities. During the past year, Dr. Lutz initiated many activities in response to teachers' concerns; continued efforts will be made to move the executive director into a position of facilitating--rather than coordinating--collaborative programs. Dr. Lutz also is a member of the governing bodies of DMC; she reports to Dr. Brown, who oversees fiscal matters and long-term planning. Dr. Lutz also helps to gain community support for the collaborative. During the year, Dr. Lutz appeared on two local cable television programs that featured the DMC, "Homeroom Television Broadcast" and "Ask the Superintendent." These programs, in combination with articles in local newspapers and publications, have given DMC a positive public image in the community.

The Durham Mathematics Council's governing structure includes a Board of Directors and its committees and a teacher Steering Committee. Policy decisions regarding the direction of the DMC fall under the jurisdiction of the Board of Directors. Members of the Board of Directors serve on five committees: the Advisory Committee, the Finance Committee, the Public Relations Committee, the By-laws Committee, and the Nominating Committee. In September, 1987, a form was sent to each Board member to allow them to indicate their preference for committee assignments. The chair of the Board then made the committee assignments. The Steering Committee has responsibility for developing program ideas for DMC and for providing a liaison with all the teachers in the Council. The Steering Committee gives input to the Executive Director, who reports on activities to the Board of Directors.

The Board of Directors is comprised of sixteen members, including eight from area businesses and industries, two from local institutions of higher education, one representative from each school system, a representative from NCSSM, and one teacher from each school system. Dr. Lutz and Dr. Brown are ex-officio members of the Board. Dr. Brown had initial responsibility for identifying Board members. The chair of the Board for 1987-88 was Marie Eldridge, Director of the Center for Education Studies at the Research Triangle Institution. The Board's by-laws stipulate that it will meet at least six times each year under the leadership of a chairman and vice-chairman. Members are to serve staggered three-year terms. New members are nominated by a committee of the Board and then elected by a simple majority of Board members in attendance.

During 1987-88, the Board of Directors met six times. The meetings were held generally on Thursday afternoons from about 3:30 to 5 p.m. Attendance at the meetings ranged from nine to fifteen people with an average attendance of twelve. The agenda of the meetings consisted of committee reports, a report on past and future activities by the Executive Director, and any additional items that any member wanted to report or discuss with the group. Besides the committee reports, topics discussed during the year included the permanence proposal, the feasibility of combining the Board with the Steering Committee, and a proposal to have a DMC Partners project that would pair volunteers from private industry with teachers so that each could visit the other's place of work. A report from the Finance Committee was made or its activities were discussed at each of the meetings. At the summer and fall meetings, results of previous solicitations were reported and a strategy for future solicitations was discussed. During the year, members of the Board met with the two superintendents of schools to confirm their districts' continued support and to solicit a commitment for funds. At the March Board of Directors meeting, the 1988 Fund-Raising Campaign Schedule was distributed. The May report of the committee announced that a total of $26,500 had been committed to date.

The Advisory Committee reported to the Board on the teachers who had received grants from the DMC to attend professional meetings, to purchase software or other instructional materials, and to work during the summer to develop materials or attend courses. The Public Relations Committee reported to the Board on its efforts to publicize the work of the DMC in outlets such as the newspaper, districts' newsletters, and local cable television. One outcome of the efforts of the Public Relations Committee was the appearance of Dr. Lutz on the two television programs noted above. The PR Committee also considered reaching parents through the PTA, but no further action on this was reported.

At the February meeting, the By-laws Committee suggested two changes in the by-laws. One change would have the Board chairperson appoint the chair of the Advisory Committee rather than having the Advisory Committee make the appointment. The second was to have the by-laws explicitly state that the Nominating Committee, chaired by the vice chair of the Board, consist of members who would be serving their final year. These recommendations were approved at the March meeting. The report of the previous year's Nominating Committee was presented at the September, 1987, meeting at which Dr. Imogene McCanless was nominated vice-chair. The Nominating Committee had not met prior to the Board's May meeting so that nominations had not yet been made to fill Board vacancies for the 1988-89 school year.

The Advisory Committee is the most prominent committee of the Board and is responsible for distributing mini-grants and travel grants. The committee meets at least quarterly to evaluate the professional development plans submitted by teachers. Reports of Advisory Committee meetings were given to the Board of Directors at the November, February, March, and May meetings. The Advisory Committee frequently met before or after the Board of Directors' meeting. Five Board members served on the committee during 1987-88, including two teachers, two business representatives, and one from higher education. In addition, Dr. Lutz met with the committee and contributed considerably to its agenda. Ms. Vivian Leper Ford, a teacher, heads the Advisory Committee.

In addition to issuing teachers travel grants and financial support for materials development or in-service opportunities, the Advisory Committee made some decisions on the purchase of calculators. Teachers who submitted applications received grants for purchasing classroom sets of calculators. In addition, the committee decided to purchase two classroom sets of graphing scientific calculators to be kept in the Resource Center and available for teachers to check out. Two proposals from teachers were denied funding. One request to support a teacher for one week to develop a grade book program was denied because it was felt that adequate programs were already available. Another proposal to fund a computer lab at a high school was denied because it was felt that that would deviate from the original purpose of the DMC.

The Steering Committee was comprised of sixteen teachers, at least one from each of the junior and senior high schools in the city and county. Two teachers from one school did attend the meetings. As a result of membership turnover, only five teachers who had served on the committee during 1986-87 remained at the end of 1987-88. In addition, four teachers joined the committee during the year to replace those who had resigned due to school transfers, or those who failed to attend meetings. Only one male teacher served on the committee in 1987-88. Dr. Lutz prepared the agenda in response to committee interests and input. A key role of the Steering Committee is to serve as a sounding board and conduit for information between teachers in the schools and the collaborative.

Although it planned to meet monthly, the Steering Committee met three times during the 1987-88 school year. Topics of discussion included guest speakers, the meeting schedules of the network groups, ways to improve the communication between teachers and local businesses as a means of generating mathematics problems to be used in the classroom, and potential topics for collaborative programs. At its March meeting, Dr. Brown met with the group to hear its ideas for long-range planning for the DMC; this was the primary avenue by which teachers provided input into the permanence proposal process.

The vision for permanence set forth in the DMC's May, 1988, proposal to the Ford Foundation built upon the past programs of the Council, with special emphasis on the collaborative's intent to draw teachers into the process and issues of mathematics reform, and then to support them in their role as change agents for curriculum reform. A key aspect of this process is networking among teachers and mathematicians in higher education, business and industry. Dr. Brown drafted the proposal with input from the DMC staff, the Board of Directors, and teachers. In addition, a draft of the proposal was submitted to individual reviewers, including one from Duke University and a mathematics supervisor.

D. Project Activities

During 1987-88, the Durham Mathematics Council sponsored a variety of activities designed to foster teachers' professional growth. In addition, the council provided support for activities sponsored by other agencies, including publicity and funding to enable Durham teachers to attend.

Reception and Dinner Meeting

Glaxo, Inc., Reception

On September 22, 1987, the Durham Mathematics Council hosted a reception for all area mathematics teachers as a kick-off for the new school year. All collaborative members, including mathematicians from industry and higher education, were invited to the event, which was held from 4-6 p.m. at Glaxo, Inc., at the Research Triangle Park. Dr. Henry Pollak, recently retired Assistant Vice-President at Bell Communications Research, Inc., spoke on, "From Fractions to New Frontiers," describing how analysis of a simply stated problem can progress from grade school mathematics to the frontiers of research. More than eighty teachers and university and industry representatives attended a Glaxo-sponsored reception following the lecture.

All of the participants enjoyed Dr. Pollak's presentation and were most enthusiastic about the event. One teacher commented, "Dr. Pollak did not talk down to us. He assumed correctly that we all loved math as he did. For the first time in a long while, I was immersed in math at a higher level." Another said, "What a joy to have meat instead of meringue! Too many speakers underestimate our background and interest. Dr. Pollak inspired us all." A third teacher added, "Excellent program. Dr. Pollak was lucid and inspiring. I thoroughly enjoyed his presentation. We should have more people of his caliber. I learned a great deal." Another said, "It was great to watch a fellow gung-hoer. The program had no weaknesses. Dr. Pollak's enthusiasm for math is contagious. Wish program could have been longer. He stopped before I was ready." Another teacher, praising the collaborative for the opportunities it offers to teachers, commented, "If DMC did nothing but expose us to people such as Pollak, David

Johnson and Richard Houde, it would have fulfilled its responsibility. A marvelous afternoon."

The reactions from the business and university community were equally enthusiastic. An insurance executive said, "I was a social studies/law major. As such, I was at sea, but enjoyed the delight math people had in the presentation." A representative from Durham Technical Institute said, "Very worthwhile activity, stimulating. I would not have changed anything."

Dinner Meeting

The Durham Mathematics Council hosted a dinner meeting on March 8, 1988, at the Sheraton University Center. All DMC members were invited, with registration limited to the first sixty who responded. Ultimately, sixty-two persons, including twenty-six county teachers, seventeen city teachers, eight school administrators, and several representatives from both the business and university communities, attended. The dinner meeting was designed to present DMC teachers with more information about the Career Ladder Program and the North Carolina Effectiveness Teacher Training Program, and to provide teachers an opportunity to speak out on the Career Ladder Program before it was adopted by the school district. Following the dinner, Dr. Mark Driscoll, Director of the UMC Technical Assistance Project, moderated a panel discussion of the Career Ladder program. The panel consisted of three teachers from districts where the program has already been implemented, as well as David Holdzkom, the Department of Public Instruction administrator in charge of the program.

While all of the teachers felt that the evening was very worthwhile, some expressed a concern that the panel was weighted in favor of the Career Ladder Program. One teacher said, "This was a fine professional and social gathering. The interaction with others from different systems was good. It gave us an opportunity to hear different points of view and form our own interpretation." Another said, "The panel was controversial and seemed heavily weighted in favor of the program." A third teacher commented, "The strong points of the event were the solid varied points of the teacher evaluation instrument and the experience and expertise of the panel. I do wish the viewpoints could have been more equally distributed pro and con." Another added, "There was a good selection of panel members. They offered a wide variety of opinions. We had an opportunity to ask questions and make comments. An excellent program, more like this would be appreciated." A representative from the North

Carolina Department of Public Instruction said, "It is an excellent idea to get teachers involved in a discussion of 'top down' programs."

Workshops and Seminars

David Johnson Workshop Follow-Up

On October 8, 1987, the collaborative sponsored a follow-up seminar for teachers who would like to complete the continuing education credit requirements for the Teacher Effectiveness workshop that was presented by David Johnson in June, 1987. A minimum of ten hours is required for a CEU. The follow-up seminar was necessary to reach this requirement. Mr. Johnson, who is chairman of the mathematics department at a suburban Milwaukee high school and author of several books, had discussed techniques for organizing a mathematics class and using instructional materials in a time-efficient manner. In order to earn the continuing education credits associated with the workshop, teachers were required to write a short paper explaining how they had implemented at least three of Mr. Johnson's ideas in the classroom.

The five teachers who participated in the follow-up seminar found it very worthwhile. One teacher said, "Great, super. I really enjoyed the discussion with city and county teachers." Another added, "I enjoyed it very much. It was nice hearing how other teachers are implementing the ideas in the classroom."

IBM Workshop and Follow-Up

On October 20, 1987, IBM sponsored an all-day workshop for DMC teachers. The workshop, which was open to the first twenty-five teachers who registered, was held at the IBM's facility in Research Triangle Park. The program consisted of two 60-minute and two 30-minute presentations by IBM employees, tours of various IBM departments, and lunch with the presenters and other IBM employees. Topics included "The Programming Development Cycle" and "On-the-Job Math."

All twenty-five participants seemed to enjoy the workshop, which had been jointly planned by a DMC mathematics and computer teacher, a member of the DMC Board of Directors, and an employee of IBM. One teacher commented, "Aside from what we learned, it was great to be treated as a special person of real worth. Often teachers lose a sense of their importance; today it was restored." Another added, "The talk on recruiting was most interesting. I will be able to take much information back to my students who are interested in programming as a career." A third teacher said, "A marvelous day! It was good to see how the other half lives and works. The folks at IBM were great hosts and hostesses. I particularly enjoyed the tour of the facility. I believe I have a better understanding of how software is developed."

The presenters from IBM also felt that the workshop was very worthwhile. One said, "We thoroughly enjoyed having the teachers. I feel that they and we learned a great deal." Another added, "I hope that we communicated to students, through teachers, the increasing need for qualified people."

A follow-up session for teachers who wished to earn continuing education credit for the activity was held November 17 at NCSSM. Four teachers participated.

Calculator Workshop

On May 6-7, 1988, the Durham Math Council sponsored a two-day workshop at NCSSM to enhance teachers' awareness of new calculator technology and how these calculators will force changes in how mathematics is taught in high schools, as well as to instruct them in the use of the Sharp EL-5200, a new graphing calculator with 192 functions. John Kenelly, a professor at Clemson University, led the workshop and was paid an honorarium by DMC. Registration exceeded expectations; while enrollment was to have been limited to the first thirty applicants, thirty-four teachers actually participated. Each participant who completed the workshop received a calculator valued at $80 each, which was funded by DMC.

All of the participants seemed very appreciative of the opportunity to attend the workshop and very enthusiastic about what they had learned. One teacher commented, "This workshop has increased my knowledge and enhanced my skills. I now have another resource for solving various problems. This workshop has encouraged me to want to explore graphing more deeply. I will try to use what I have learned about matrices to learn even more about them." Another added, "Very informative. I learned that allowing the students to use the calculator in the classroom is not as detrimental as I previously thought. I can see now that it can help students to understand concepts more quickly. I am enthralled with the idea that all math can be taught to all students with the help of a calculator." A third teacher said, "This was a good introduction to next level of calculators. . . . I learned what is coming. We need to teach tomorrow's math today instead of yesterday's. I would have preferred more calculator time and less lecture on why this is important. I know it is important." A department chair commented, "I had an opportunity to listen and discuss the future of calculators in math education with an individual who is in the forefront of these innovations. . . . I am gradually seeing the need to change our instruction to include calculator use. The students will enjoy it." Another teacher noted, "I hope someday to be able to use calculators in all classes, but that order must come from the top down. Teachers don't have the luxury of choice."

A follow-up session was held May 25, 1988, for workshop participants who wished to receive one continuing advancement credit. The ten teachers who attended the session shared how they had used what they learned at the calculator workshop in their classrooms.

Contemporary Topics in Mathematics with Applications in Grades 7-12

On June 27-July 1, 1988, the Durham Math Council, the NCSSM Mathematics and Science Education Network, and the National Science Foundation co-sponsored a workshop for Durham mathematics teachers in grades 7-12. The Mathematics and Science Education Network, directed by Ms. Dorothy Doyle, provides NCSSM outreach to North Carolina Schools and is funded through the state. The network supports seminars and workshops throughout the year. The DMC workshop was led by four of the DMC teachers who had attended a national two-week workshop at NCSSM in July, 1987, on new topics for the mathematics curriculum. One of the stipulations of that workshop was that participants organize and teach a workshop for teachers in their home districts.

The one-week workshop, which was held at Jordan High School, addressed some of the goals embodied in the curriculum standards proposed by NCTM. Topics included functions, geometric probability, matrices and data analysis. Both computer lab time and problem sessions were included in the daily schedule.

Although the workshop could have accommodated twenty participants, only fifteen teachers registered. Each of the participants received free materials and software, three renewal credits and a $100 stipend.

The response to the workshop was very positive. One teacher commented, "I enjoyed this workshop and found it very worthwhile. There were lots of good materials and software, all very applicable to my teaching. I particularly liked the chance to interact with other math teachers. Some of the lectures were a little confusing and disjointed. Sometimes the purpose seemed to be unclear. Most of them, however, were very good." Another added, "A very worthwhile event, well organized. The teachers were strong in the lessons they taught. There was good communication among the teachers attending. We had extra help for the computer and calculator work. The student tutors were great." [NCSSM students were hired to provide assistance as needed such as setting up computers or answering questions on how to use the computer.] A third teacher said, "The application of software was excellent. The discussions were most helpful, as was the sharing of ideas. The student tutors and their help in the use of calculators was invaluable. We really needed more problems. . . . We should have follow-up sessions where teachers could discuss how they used materials."

NCSSM 1987 Summer Workshop and February 1988 Follow-up

On July 5-17, 1987, the Mathematics Department of the North Carolina School of Science and Mathematics conducted a twelve-day workshop on the new fourth year mathematics curriculum the department is developing. The workshop, which was funded through a proposal submitted by NCSSM to the National Science Foundation, was designed for selected teachers from the mathematics collaboratives established by the Ford Foundation. The course stressed an applications approach to the study of pre-calculus and covered six modes of mathematical thought: geometry, data analysis, probability and statistics, mathematical modeling, computers, and finance.

The Durham Math Council helped to plan and promote the workshop. Teams of teachers from nine of the UMC projects, including four teachers from the DMC, attended. Each team of teachers that participated was expected to pilot test some of the newly designed instructional units during the 1987-88 school year. They were also to conduct a one-week workshop during the summer of 1988 for teachers of grades 7-12 in their home district.

The workshop was very successful; more than thirty-eight UMC teachers participated. The teachers were enthusiastic about the new instructional materials and the opportunity to interact with teachers from other collaboratives. The four DMC teachers who completed the written evaluation form agreed that the event was worthwhile. When asked to list its strengths and high points, one teacher wrote, "Topics, software, excellent teaching." Another wrote, "Watching the presenters, learning the material, meeting with other math teachers." While it seems that all the teachers would agree with the teacher who wrote, "A truly worthwhile experience!", a few teachers suggested that there was "too much in too little a time period."

February Working Meeting

On February 11-13, 1988, the teachers from all nine UMC collaboratives who had participated in the NSF Summer Workshop returned to NCSSM for a two-day working meeting to talk about the curriculum they were pilot testing and to plan the workshops they would present during the summer.

All DMC teachers were invited to participate in two sessions of the two-day meeting. On Thursday afternoon, February 11, Dr. Thomas Tucker, a professor at Colgate College and Chairman of the AP-Calculus program, spoke on the impact of calculator technology on the curriculum. A reception preceded Dr. Tucker's presentation to provide the DMC teachers an opportunity to talk with teachers from the other collaboratives.

All of the DMC teachers also were invited to attend a luncheon meeting to hear Dr. Gerry Rising, a professor at SUNY-Buffalo, speak on the NCTM *Standards*. Dr. Rising worked on the *Standards* Committee for grades 9-12. Due to scheduling conflicts, the four teachers who had participated in the 1987 Summer Workshop, along with a few other DMC teachers, attended the two sessions.

National Conference on Mathematics Reform and Teacher Professionalism

On June 23-24, 1988, the Durham Math Council, with support from NCSSM and the Education Development Center of Newton, Massachusetts, sponsored a conference on "Mathematics Reform and Teacher Professionalism" at NCSSM. More than 100 mathematics educators from nineteen states and the District of Columbia attended the conference, which was designed to inform and guide the broader mathematics community in its efforts to improve mathematics at the pre-college level. The purpose of the two-day event, which included presentations and discussions led by distinguished mathematicians and educators, was: (1) to review the recommendations for change by the National Council of Teachers of Mathematics and the Mathematical Sciences Education Board; (2) to explore the role of teachers as designers, critics and consumers of a changing curriculum; (3) to consider local alliances as a vehicle for mathematics reform; and (4) to explore approaches to enriching the mathematics curriculum for all students.

The Durham Mathematics Council offered to pay the $125 registration fee for DMC teachers who wanted to participate in the conference. The twenty-two teachers who took advantage of this opportunity felt that the conference was very beneficial. One teacher said, "The panelists and presenters were excellent. I grew a great deal in my confidence in my ability to decide what I want to change and in trying to find out how to make those changes. It was impossible to attend all the sessions I wanted to attend." Another commented, "I feel much better about the reforms since we had an opportunity to explore what should be the emphasis toward reform and what we can do to get the change that we want and can live with. The speakers were tremendous." A third teacher added, "I enjoyed the interaction with teachers from such varied places and situations. The afternoon sessions were too long. The organization was great. The panelists were very knowledgeable." Another said, "I wish I could have had the opportunity to hear a few more of the experts in the small groups; it was hard to choose. I wish that some of the speakers had two time slots. Everything was great, the participants, the subject matter, the organization, the whole idea."

Subject Area Networks

These teacher-generated subject area networks are an important support vehicle that emerged as an outgrowth of DMC activities. The networks provide teachers with opportunities to meet in small groups to discuss issues and to share information on specific subjects that are of interest to the participants. The networks meet at NCSSM. The meetings, which are planned by the teachers, are publicized through the DMC newsletter and special bulletins mailed to all mathematics teachers.

Networks have been established for Algebra II/Pre-calculus, Geometry, Middle School Mathematics and Algebra I.

Algebra II/Pre-calculus Network

The Algebra II/Pre-calculus Network, which was established in spring 1986, was the first of the networks to be formed. It is designed to bring together city and county teachers of Algebra II, Algebra III, Pre-calculus and Calculus to share ideas and to help one another with problems.

This network met seven times during the 1987-88 school year: October 16, 1987; December 10, 1987; February 2, 1988; March 15, 1988; April 19 and 26, 1988; and May 17, 1988. Overall, the series of network meetings focused on probability and statistics. Topics addressed at individual meetings included introductory combinations, counting problems, combinations and permutations and problem solving in the curriculum. Many of the sessions were led by Betty Peck, a high school mathematics teacher who is also the on-site observer for the DMC. At the October meeting, the teachers received training on the use of a problem bank for Algebra II. The problem set had been developed over the summer by Pat Robbins, a high school mathematics teacher who had received a DMC grant to write problems for Algebra II using the Appleworks data base to store and catalog her work. Attendance at each of the meetings ranged from seven to thirteen teachers.

The teachers who participated in the network seemed to find it valuable. They not only commented that they learned a lot, but that they enjoyed working with other mathematics teachers. After a meeting that focused on problem solving, a teacher said, "This was an example of cooperative learning. I really like working with others." Another commented, "These sessions are good for me--I not only learn about probability, but am able to get other questions answered about material I teach." Comments after the network's October meeting, at which teachers received copies of the problem bank software developed under a DMC grant, included: "This was truly a productive session"; "This is something I can really use. It will free me from a lot of routine work and enable me to use that time for more important things"; and "Wonderful way to individualize instructions, specific work sheets for specific difficulties can be created in minutes while the student waits. I feel that I can be a better teacher using this material and it was free!" The on-site observer stated, "An excellent useful activity; the sort of thing the collaboratives ought to be doing."

Teachers' reactions to other network meetings have been equally positive. Comments have included: "In our small group, all questions are answered and discussed. I love the fellowship and communication with other teachers"; "An excellent opportunity to refresh skills for problem solving. I really learn in the small group environment"; and "I still believe that the networks are the most valuable activity we have. . . ."

Geometry Network

The Geometry Network was established to address issues and techniques related to the teaching of geometry. Since most of the participants also were involved in the

Algebra II/Pre-Calculus Network, the Geometry Network met only once during the 1986-87 school year and once during the 1987-88 school year. This year's meeting was originally scheduled for January 12, 1988, but was rescheduled on February 9 due to a snowstorm. Eleven teachers attended the event, which was held at the NCSSM and focused on new approaches to high school geometry, including ways that proof is being taught. Participants expressed their enthusiasm for the network and for the opportunity to work together. One teacher commented, "As a beginning teacher, I was very happy to find teachers working so well together to try to make instruction better." Another said, "It was encouraging to find that others were not satisfied with our approach to geometry. Hopefully some new ideas will be implemented as a result of our meeting." A third teacher added, "This was a most productive session. I find the network groups to be the most profitable activity we have."

Middle School Math Network

During the spring of 1987, many teachers expressed interest in forming a network for mathematics teachers of grades 6-9. Because considerable recruitment work was necessary, however, the Middle School Math Network was not established until the 1987-88 school year. Attendance at meetings during the year fluctuated greatly without apparent reason.

Sixteen teachers attended the middle school network's first meeting on October 22, 1987. Carolyn Jackson, Assistant Superintendent for Instruction for the Durham County Schools, spoke on "Mathematics in the Middle Schools." The presentation was designed to help prepare the mathematics teachers for the district's reorganization from junior highs to middle schools that will occur in the 1988-89 school year. The teachers who attended found it both worthwhile and informative. One teacher commented, "The speaker was interesting and related well to the audience. I enjoyed hearing of her experience in teaching. I was encouraged to hear that the methods being used work." Another added, "An excellent presentation with very good audio-visuals. I found this to be informative and helpful. The sharing of ideas was particularly valuable." A third teacher said, "The ideas for relating to students were most helpful. I enjoyed the open discussion by teachers."

The mid-year meetings of the Middle School Network were held at NCSSM. On November 19, each teacher was asked to bring a math activity or idea to share with the group. The six teachers who attended planned the programs for the rest of the year.

On January 14, Joan Pierson and Rita MacMillan, both middle school teachers, shared their ideas for making decimals more meaningful to students. They also presented an overview of the manipulative materials that were developed by Dr. Miriam Leiva of the University of North Carolina-Charlotte. Six teachers attended.
On February 25, the nine teachers in attendance discussed the middle school mathematics curriculum, with a special focus on the pre-algebra and algebra that should be taught in middle school.

The Middle School Network met again on April 21, 1988. Discussion once again centered on the mathematics to be taught in the middle school. The seven participants, along with Project Director Jo Ann Lutz and Ellen Pechman of the Center for Early Adolescence at UNC-Chapel Hill, worked towards a consensus on how to plan for the establishment of the middle schools, which are to be instituted in Durham in the 1988-89 school year. The teachers appreciated the opportunity to get together and to plan for the transition. One teacher commented, "Without this opportunity we could not speak freely and openly of our reservations about the middle school concept." Another added, "This was a good sharing of ideas. We reached no conclusions, but I feel that we are making some headway toward agreement as to how curriculum should be designed." A third teacher said, "It was very nice to have Ellen Pechman as a sounding board for our concerns and ideas."

Seven teachers attended the last meeting of the Middle School Network for the 1987-88 school year, which was held on May 19, 1988. At this meeting, which was a follow-up to the April meeting, Ellen Pechman presented a program, "The Mathematics Assessment for the Middle Grades." This planning process provided a context and a procedure for making decisions about curriculum and instruction. The teachers reacted favorably to the discussion and at the end of the session, one of the participants volunteered to work with Dr. Pechman on her middle school mathematics group.

Algebra I Network

The Algebra I Network, which was the last of the four subject area networks to be formed, held its first and only meeting on October 15, 1987. The seminar was designed as a discussion of the Algebra I Saxon textbook and how to use it effectively. Only six teachers attended the meeting. The on-site observer reported that while participants were disappointed by the poor attendance, they felt that the session itself was valuable. One teacher commented, "Worthwhile event. Those of us using this text should get together to discuss our progress throughout the year." Another added, "This was a most informative session. The teachers' questions were good." A third teacher said, "Many interesting ideas were shared. I really enjoyed the sharing. I learned some useful information to use in my class." Another teacher added, "The event was helpful. I thought more people were using Saxon. We need more feedback from other schools. There were not enough people present."

DMC Resource Center

The Teacher Resource Center was established in spring of 1987, in office space provided by NCSSM. The Center, which is open between 8 a.m. and 5 p.m. weekdays, provides teachers access to computers, software, and text and supplemental materials and also serves as a work place outside of the school site. During the summer of 1987, the Center expanded its selection of materials for teacher use. The new materials included a set of software donated by the Cleveland collaborative. DMC teachers are encouraged to help organize the Resource Center and to suggest materials for acquisition by the Center. The Center was not used to the extent that it could have been, which continues to be an issue for DMC.

Triangle Math Club

During the 1986-87 school year, the Durham Mathematics Council helped schedule several events to foster the success of the Triangle Mathematics Club, an organization designed to involve mathematicians from all sectors and to promote the growth of mathematics and mathematics education. The club, which is modeled after the Chicago Metropolitan Math Club, provides an opportunity for all persons interested in mathematics from Durham and the surrounding Triangle area (Wake, Durham, and Orange counties) to meet in a social setting and to listen to and interact with one another and with invited speakers on various mathematical topics. While the Triangle Math Club is partially funded by the DMC, most of its revenue comes from its members, who pay $8 annual dues. In addition to providing some financial assistance, DMC also helps to identify speakers and to disseminate information on club meetings and activities.

The Triangle Math Club held three dinner meetings during the 1987-88 school year: December 12, February 16, and May 10. Participants paid for their own meals. Costs for speakers were paid by the club.

Fall Dinner Meeting

The first meeting of the Triangle Math Club for the 1987-88 school year was held December 15, 1987, at the Cock of the Walk Restaurant in Durham. Dr. David Peterson, Adjunct Professor at Duke Fuqua School of Business and Institute of Statistics at Duke University, spoke on "The Use of Statistics in Litigation." All Durham-area residents interested in mathematics were invited; sixteen attended, including eleven teachers. While participants and organizers were disappointed about the poor attendance, those present did enjoy the evening. One teacher commented, "We need to get more people at our meetings. Perhaps if we had them regularly, this would be possible. Good presentation." Another added, "The facilities were very good. Dr. Peterson was most interesting. Sorry so few attended." A third teacher said, "I was very interested to learn that statisticians often disagree about methods and results." Dr. Peterson commented, "I enjoyed the evening and the intelligent questions."

Winter Dinner Meeting

A dinner meeting of the Triangle Math Club was held February 26, 1988, at Landlubber's Seafood Restaurant in Durham. Dr. Deborah Dawson, Assistant Professor at Duke University Medical Center, spoke on "The Birth of Biometry," and presented a thorough introduction to two famous mathematicians: Francis Galton, a renowned explorer of Africa who was a proponent of eugenics, and his protege, Karl Pearson, a statistical pioneer and founder of Biometrika. Seventeen club members, including thirteen teachers, attended, which was fewer than anticipated. The presentation was well received. One teacher commented, "Very interesting talk. Nice to hear someone talk about an almost personal acquaintance with famous mathematicians." Another commented, "Good topic, good speech, good company, good food." A third teacher said, "I enjoyed the talk very much. Deborah was enthusiastic and lively. She is obviously very interested in her topic. I am pleased to be associated with a group that promotes math." An assistant professor at the University of North Carolina-Chapel Hill said, "It was an interesting lecture. I discovered some things I had not known." A retired purchasing agent added, "We learned how many different ideas contributed to the development of biometrics. It is always nice to see the members of the group."

Spring Dinner Meeting

The Triangle Math Club held a spring dinner meeting on May 10, 1988, at T.K. Tripps Restaurant, which is located between Durham and Chapel Hill. Twenty-one persons, including sixteen teachers, heard Dr. Fred Wright of the University of North Carolina-Chapel Hill speak on "Numbers and Magnitudes: Some Historical Comments." Everyone seemed to enjoy the presentation and the opportunity to meet with their colleagues. One teacher commented, "Events of this nature are always beneficial to me. I have the opportunity to dialogue and brainstorm with teachers, administrators, and expert speakers. The atmosphere is always informal and relaxing. Problems can be discussed scientifically and solutions are given." Another added, "Great fellowship and networking. It is great to hear the discussion of some of the concepts we do not deal with every day. It is very good to get advice from a college professor as to how we should prepare our students." A third teacher said, "I learned a lot of the history behind mathematical concepts. It will certainly cause me to be more conscious of what I stress to students about ratios, rounding, etc. I find meeting with others who are involved in working with things that interest me to be very stimulating."

Grants

DMC Mini-Grant Program

DMC's Mini-Grant Program supports innovative efforts to enrich and strengthen the mathematics curriculum in the Durham city and county schools. Mini-grants provide seed money for instructional experimentation and equipment, and for the development of new curriculum and materials. In addition, DMC has provided mini-grants to allow teachers to attend local training programs during the summer. Grant applications are reviewed and approved by the DMC Advisory Board.

Two cycles of funding were scheduled during the 1987-88 school year; deadlines were set for December 11, 1987, and April 11, 1988. In January, three DMC teachers were awarded grants totaling approximately $880. The funds were used to purchase problem-solving materials, calculators, and a modem. Nine mini-grants were awarded to twelve DMC teachers during the second funding cycle. Seven of the grants, which totaled more than $2,000, were used to purchase a printer, software, calculators, and student motivation materials, as well as to fund a teacher's attendance at summer school at UNC. An eighth mini-grant of approximately $700 will pay a teacher's salary for two weeks to enable her to collect and develop mathematics games for middle schools, and a ninth grant of nearly $6,000 will pay the salary of two teachers, one from the city and one from the county, who will work for six weeks with two other county teachers to develop a self-paced programming curriculum. (The county school system has agreed to pay the salaries of the other two teachers.) In addition to the above, DMC also provided $700 for two teachers to work together for three days reviewing and evaluating video materials and writing a user guide for the Sharp EL-5200 Scientific Calculator for use in the classroom. Although allocated during 1987-88, the work will be done during August, 1988.

Travel Grants

In addition to the mini-grants, DMC awarded fifty-one travel grants to enable members of the Durham Math Council to attend a variety of state, regional and national mathematics conferences and institutes.

NCCTM Mini-Grant Program

In the 1987-88 school year, the North Carolina Council of Teachers of Mathematics instituted a mini-grant program designed to promote excellence in mathematics education. The program was developed to provide $500 in funds in each of the three NCCTM regions for special projects and research which will enhance the teaching, learning, and enjoyment of mathematics. While three DMC teachers applied for grants, none of them received awards. Proposals from Durham competed with other proposals from the same NCCTM region. The NCCTM Awards Committee and the elected officers from the three NCCTM regions evaluated and selected the proposals to be funded. In total, $500 was allocated for awards in each region.

State, Regional and National Conferences and Seminars

In order to foster professional growth and teacher empowerment, DMC alerted teachers to the various national and regional meetings and workshops, encouraged teachers to participate in such events, and provided funds when necessary. Between July, 1987, and June, 1988, the Durham Math Council supported attendance at nine state, regional and national meetings and conferences and two UMC project meetings. In exchange for council support to attend out-of-state workshops, teachers were expected to make presentations to share some of their new knowledge with other Durham teachers.

Woodrow Wilson One-Week Summer Institute

DMC arranged for two teachers from the county to receive ten CEU's from the school system for attending a one-week Woodrow Wilson Summer Institute for teachers of secondary school mathematics at Columbus College, Columbus, Georgia, on July 6-31, 1987. The DMC paid transportation costs and registration fees for the two teachers. During the summer of 1988, these teachers planned to present a statistics workshop for other DMC teachers.

North Carolina Council of Teachers of Mathematics (NCCTM) Conferences

The North Carolina Council of Teachers of Mathematics sponsored a statewide conference in the fall and three regional conferences in the spring. DMC supported teachers' attendance at the state conference and at two of the three regional conferences by awarding travel grants to twenty teachers. Six members of the Durham Math Council received travel grants ranging from $48 to $75 to attend the NCCTM State Conference, held October 1-2, 1987, at Winston-Salem, North Carolina. Two teachers received grants of $78 to attend the NCCTM Math Conference at Greensboro on March 10-11, and twelve DMC teachers received funds ranging from $16 to $22 to attend the NCCTM conference at Raleigh on March 11, 1988.

University of Chicago Third Annual User's Conference

Four DMC teachers received travel grants of approximately $500 to attend the University of Chicago School Mathematics Project User's Conference in Chicago on November 7-8, 1987. The conference, which is held under the auspices of the UCSMP, is designed to provide information and support to teachers using or interested in using the mathematics curriculum being developed by the UCSMP. The curriculum, which is a comprehensive program to upgrade mathematics education for the average American student, seeks to convey to students the essential role of mathematics in everyday life and to equip students to use mathematics effectively. The first day of the conference the focus was on grades K-8 and the second day the focus was on grades 7-12. These teachers planned to report on their visit, but this did not happen.

National Council of Teachers of Mathematics (NCTM) Southeastern Regional Conference

Four teachers received travel grants to attend the NCTM regional conference in Virginia Beach, Virginia, on November 5-7, 1987. Due to unanticipated conflicts only two of the four were able to attend the conference.

The DMC awarded travel grants to nine teachers to enable them to attend the annual meeting of the National Council of Teachers of Mathematics in Chicago, Illinois, April 5-9, 1988. The teachers, who would not otherwise have had the opportunity to attend the meetings, received funds for both travel and expenses. Each teacher was also granted release time by the school district as the district's contribution to the Council. The teachers praised the conference and were most appreciative of the opportunity to attend.

Newsletter

The Durham Mathematics Council's newsletter is sent to the home addresses of every secondary, middle school, and junior high teacher in the city and county school systems. The newsletter, which is published once every two months, is a primary tool for disseminating information; the newsletter highlights upcoming activities, provides articles on topics in mathematics and mathematics reform, and offers reports from DMC members (including teachers who have attended conferences) and from the Council's executive director. In order to facilitate the exchange of ideas and information between teachers and non-teachers, the circulation of the newsletter will be expanded to include any mathematics user who wants to become involved in DMC activities.

E. Observations

Project Management

The Durham Mathematics Council's administrative structure is unique among the eleven collaboratives. The administrators of the DMC are associated with the project's host agency, the NCSSM, and have assumed responsibility for the collaborative in addition to their other duties. As such, its administrative structure was in place at the outset of the project and the roles of the director and coordinator were already defined.

This firm administrative foundation, in combination with the skills of two very capable individuals, has resulted in a very efficient, effective collaborative: A vision is developed, decisions are made, problems are resolved and programs are realized.

Teacher input into policy decisions within this administrative structure is channeled through the two teachers who serve on the Board and through the Steering Committee's advice to the director and executive director. For example, the director discussed permanence issues with the teachers on the Steering Committee to get their input as the project developed its permanence proposals. In North Carolina, many policy decisions related to the schools are made at the state level. Aware of this, the DMC held a dinner that involved nearly sixty teachers in a policy discussion about the North Carolina Effectiveness Teacher Training Program. In addition to these opportunities to affect DMC policy and to discuss state policies, teachers are very involved at the program level and exert their leadership by suggesting programs, planning activities, and leading workshops. Whereas in some of the other collaboratives teachers feel that others have retained the decision-making power, DMC teachers appear to feel empowered and very much a part of the decision-making process.

A few factors appear relevant to an explanation of teachers' general lack of concern about the DMC's administrative structure. Dr. Lutz has been very effective in running the collaborative, and has been able to devote personal attention to teachers at all district schools. As a result, teachers feel that they can approach her with a request and receive a response. In addition, Dr. Lutz is a practicing teacher and has established a good rapport with her colleagues. Teachers are aware of the quality of teaching that takes place at NCSSM, and they accept it as a model of excellence. As one DMC teacher said, "When I go to NCSSM, I see what an ideal situation could be like and wish that ours could even approach what they have there." A third and final factor is that, as a result of good management, school districts' cooperation, and effective planning, the DMC has not faced any hard decisions regarding the allocation of its resources. The districts have each provided seventy-five substitute days to be used by DMC teachers and $7,500 of unrestricted funds for the collaborative. There have been sufficient funds so that all reasonable mini-grant and travel grant requests have been funded. In short, teachers have little to complain about: thus far, they have been given what they have asked for.

Questions do arise regarding DMC and its relationship to NCSSM and its permanence. How important is the NCSSM to the DMC? How important is the DMC to NCSSM? Can the NCSSM continue to provide the collaborative's administrative structure? Can the DMC continue as it has been structured? The DMC permanence proposal has begun to address some of these questions. As a state-funded school, NCSSM can disseminate the DMC model to other areas in the state; given this, it can be argued that it is to the state's advantage that NCSSM continue to operate DMC as a viable model that can be reproduced statewide. There is no doubt that as DMC moves toward permanence, the process will provide insight into structural issues related to the development of a collaborative and into the empowerment of teachers.

Collaboration

The DMC provides a variety of opportunities for collaboration: seminars, industry site visits, networks, workshops, conferences, and the Triangle Mathematics Club. Given this array of activities, teachers have many opportunities to interact with one another and with mathematics users from industry and, to some extent, higher education. However, the degree to which relationships are formed between teachers and the other mathematics users varies by individual. When asked how the collaborative has helped in forming relationships, one teacher responded, "I have met and worked with teachers and college people I would never had known without DMC." Another noted, "I have met and talked with 'outside' mathematicians. The peer interaction is marvelous." But to the same question, another teacher mentioned an enhanced relationship with other teachers and business/industry, and then reported, "The one area which I feel is lacking is involvement of local college people." The reason for this disparity in perceptions is that representatives of higher education are involved with specific DMC activities, including membership on the Board of Directors and the Advisory Committee, participation with the Triangle Mathematics Club, and presentations at sponsored workshops. Only certain teachers are involved in these activities. Thus, not all DMC teachers have taken advantage of available opportunities to interact with those from colleges and universities. The higher education sector is not as prevalent in DMC as it could be.

What is clear is that the teachers are interacting more with one another and believe that they are benefitting from this interaction. One teacher reported, "Mathematics teachers are now working together to increase our competence and our influence. We are no longer alone." Another commented on the change in the department chair: "He has urged others to share what they have learned and has provided opportunities for them to do so." Opportunities for this interaction include the networks that have been formed, the seminars, and the dinners at which teachers are able to socialize. This informal collaboration is affecting the working relationships of teachers in the schools. As one teacher noted, "We have been able to get out of the classroom to learn because of pay provided for substitutes. As a result there is much more sharing. The staff gets together and talks more mathematics. The department actively looks for materials and information to take to teachers."

Professionalism

Teachers active in the DMC are becoming more professionally involved. The DMC has provided teachers with the resources and support to attend professional meetings; fifty DMC travel grants were awarded during 1987-88. These, along with the commitment of the districts to provide substitute days, have increased the opportunity for teachers to attend and to participate in professional meetings. One teacher observed, "I have been encouraged and enabled to attend state, regional and national meetings. It has created an interest in and an opportunity for presenting at such meetings."

In addition, the DMC encourages teachers to test new ideas. The collaborative issues mini-grants to teachers to allow them to develop curriculum materials or a new course. One teacher, for example, used a DMC grant to develop a Pascal course over the summer. The grant eliminated the need to get a summer job so that he could devote all of his time to the course. Another teacher reflected, "The greatest change is in the availability of opportunities to increase my knowledge and skills. I feel a sense of great personal growth in my profession and feel that I am not only equipped to do a better job in the classroom but that I am doing so."

Finally, teachers have been able to purchase new, state-of-the-art equipment through DMC mini-grants--equipment that would have been very difficult to obtain through regular channels. This includes large-screen monitors for computers, software, and manipulatives. A teacher reported on the changes in working conditions due to DMC: "We have added to our equipment and the teachers are now ordering a different type of equipment." Another teacher commented, "We have acquired much more and better equipment, a large monitor, videos, and software. All of this has made my job easier and made me more effective. . . ."

As a result of all of these factors, DMC teachers are feeling more professional. "DMC has made me feel much more professional. The peer interaction and the opportunities to 'talk math' on a regular basis has filled a void," said one. Another teacher commented, "Not only do I feel much more professional, I am more professional. My colleagues and students share this opinion. I feel confident in making suggestions and have a sense of being able to make changes." And the excitement generated by the DMC has created an environment in which teachers want to be part of the collaborative. Asked about significant changes attributed to the collaborative, a teacher responded, "The DMC existence has persuaded me to stay in the Durham County system rather than move to another offered position. The rich intellectual stimulation provided through DMC is priceless."

Mathematics Focus

During 1987-88, the Durham Mathematics Council presented activities related to a variety of mathematical topics and interests. While the DMC is structured to allow teachers to pursue their own interests, a recurring theme this year was curriculum reform. In addressing this issue, the DMC presented workshops and activities that addressed new topics for the mathematics curriculum, such as a new course to replace traditional pre-calculus. And, in order to increase teachers' use of technology, the DMC has made efforts to make them aware of the new trends in mathematics and mathematics education, such as the NCTM *Curriculum and Evaluation Standards*, and to provide them mini-grants and travel grants to develop some of their own ideas or to attend professional conferences. Concurrently, the DMC has balanced this focus on the future by attending to teachers' immediate concerns through networks of teachers who address existing courses.

The DMC activities are changing the way teachers teach. According to one, "I use much more technology and put more emphasis on problem solving. I try to introduce mathematics history into my class plans. I use the computer and software much more than in the past." Another teacher commented on her different views of the mathematics curriculum. "Our curriculum has embraced the notion of finite math. We have introduced a course for those seniors who are proficient but not interested in the calculus. We have attempted to make problem solving an integral part of every course." Teachers also are better able to demonstrate applications of mathematics; according to one, the "DMC has enabled teachers to bring in more examples and relate mathematics to career and work world situations."

Teachers are beginning to recognize that changes in their own views of mathematics are affecting their students. One junior high teacher responded to a question regarding the changes in students' attitudes towards mathematics: "Our students seem to be much more enthusiastic about mathematics. They thoroughly enjoy the work with manipulatives. There is an overall sense of greater enjoyment." Another junior high teacher has raised his expectations, "I believe that we do not expect enough from our students and I have raised my expectations. We are doing more problem solving and using manipulatives to a much greater degree. I can see that we have not offered many children the mathematics they should have and am trying my best to correct that." All of these statements point to the fact that teachers in Durham are viewing mathematics differently as a result of their involvement in the Durham Mathematics Council.

F. Next Steps

The theme for the next three years will be mathematics education reform through teacher empowerment. Emphasis will be given to activities that encourage and stimulate teachers to effect change in both mathematics curricula and methodology.

Activities proposed include seminars that focus on mathematics curricula and teaching methodology; the support and enhancement of current subject-area teacher networks; the continuation of a teacher resource center; funding for national conferences and workshops; grants for curriculum and materials development; and the establishment of curriculum and textbook study committees.

In developing activities for Phase III, it was determined that a general, flexible plan was needed. During this three-year period, the responsibility for planning and implementation of DMC activities will become the teachers'. The focus will shift from specific activities to the objectives of those activities. DMC programs and events will: 1) be teacher generated, 2) be flexible and innovative, in order to generate a mathematics reform movement, 3) involve all teachers of mathematics, not just the teachers of college-bound students, and 4) contribute to mathematics reform in Durham.

During Phase III, seminars will focus on curriculum and teaching methods. In addition, teachers have requested seminars on supervising student teachers, motivational techniques, and general mathematics applications. The seminars will be designed to improve mathematics teaching and to introduce new ideas that can be implemented in the classroom.

The collaborative will continue to support the currently existing networks for middle school mathematics, Algebra I, geometry, and Algebra II/pre-calculus. In addition, networks for general and remedial mathematics are planned.

Additional out-of-school activities to be continued include the resource center at NCSSM; travel funds for teachers to attend state and national meetings, participation in workshops and visits to schools with model programs; teacher grants for studying mathematics or developing projects; and curriculum and textbook studies.

In-school activities, which will focus on implementing reform, will fall into two categories: introducing new, innovative programs into the classroom, and mini-grants of up to $300 for classroom improvement.

The collaborative will continue to support networking activities. These include the Triangle Math Club, which will provide opportunities for teachers to interact on a social basis with other professionals interested in mathematics; a series of dinner meetings, which will feature an invited speaker who will discuss relevant topics in mathematics or mathematics education; and the newsletter, whose distribution will expand to include any mathematics user wishing to become involved in DMC activities.

SUMMARY REPORT
LOS ANGELES URBAN MATHEMATICS/SCIENCE COLLABORATIVE (LAUM/SC)

by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Los Angeles Urban Mathematics/ Science Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Los Angeles Urban Mathematics/Science Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1987; meetings held during the annual NCTM Conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

LOS ANGELES URBAN MATHEMATICS/SCIENCE COLLABORATIVE (LAUM/SC)

A. Purpose

The Los Angeles Urban Mathematics/Science Collaborative is the official title of the thirty-five-member Advisory Committee to the Los Angeles Educational Partnership. This committee, established in 1986, was created from the consolidation of the advisory committees of the Los Angeles Urban Mathematics Collaborative and the Mathematics/Science Fellowship Advisory Board. The Advisory Committee currently provides direction to the Los Angeles Educational Partnership on the operation of four programs: +PLUS+ (Professional Links with Urban Schools), Mathematics/Science Teacher Fellowship, Model Technology Project, and Target Science. The Advisory Committee was restructured in order to reduce duplication of committee memberships, and to bring together those concerned with mathematics and science education.

The +PLUS+ program's goal is to broaden teachers' mathematical horizons by encouraging them to interact with their colleagues in a mathematics resource network, and to help them relate the world of work to the mathematics curriculum. It is expected that teachers will benefit from expanded horizons and increased interaction with their colleagues. +PLUS+ activities during the 1987-88 school year included an expansion and continuation of those cited in the original funding proposal: networking and collaboration among teachers, mathematics departments, and mathematics resources were expanded from the community level to encompass state and national resources; team building and leadership skills for mathematics teachers were further developed; and teachers were provided opportunities to develop, evaluate, and integrate new materials and methods into the curriculum.

It is anticipated that +PLUS+ activities will enable teachers to:

1. become a part of the mathematics resource community through interaction with mathematicians and their professional organizations;

2. perceive themselves as effective, empowered agents of the professional education community; and

3. discover new and effective ways to motivate students to study mathematics, which in turn will increase the number of students successfully completing high school mathematics programs and increase student awareness of the importance of mathematics.

B. Context

Los Angeles county, the largest urban center in California, has shown a steady and steep increase in population over the last decade. Since 1980, the area has grown by 11 percent to the current population of 8.3 million, with the majority of new residents coming from an ethnic/minority background. Hispanics account for 70 percent, blacks account for 15 percent, Asians 10 percent and all other groups 4 percent of the total population growth in the area. The majority of this growth stems from births in the county; however, a rising number of immigrants (one sixth of the total number of immigrants to the United States) choose to reside in the Los Angeles area. Because of limited opportunities for educational and occupational training for many minorities, more than 20 percent of all children in Los Angeles county live below the poverty level.

The county incorporates eighty-two public school districts consisting of 228 elementary, 39 high schools and 1,267 unified schools (869 elementary, 188 junior high, 133 high schools and 141 continuation schools). Enrollment in these districts ranges from fifty-five students in the smallest district to approximately 600,000 students in the largest school district: the Los Angeles Unified School District. Enrollment has increased from 1.21 million students in 1980 to 1.32 million students in 1988, a gain of 8 percent, while the number of schools serving these students has decreased by 5 percent in the same time period. Forty-six percent of students enrolled are Hispanic, 29 percent are white, 15 percent are black, 4 percent Asian and 2 percent originate from other ethnic groups. Of the 550,000 students whose primary language is not English, approximately 280,000 exhibit limited-English proficiency (LEP). The dropout rate for the 1985-86 school year for grades 10-12 was 12 percent.

Of the 66,000 certified school staff in Los Angeles county, 71 percent are white, 13 percent are black, 9 percent Hispanic, 6 percent Asian/Pacific Islander and 1 percent account for all other ethnic groups. Thirty-one percent are males and 69 percent are females. Ninety-five percent are employed full-time at an average salary in 1986-87 of $31,343. Forty-three percent of certified staff have obtained at least a master's degree and 99 percent have at least a bachelor's degree. The median age is 43 years, of which an average of 16 years were spent working in education.

Of the fifty-three mathematics teachers from the thirteen LAUSD +PLUS+ schools in the county who filled out questionnaires for the Documentation Project, 57 percent are white, 19 percent are Hispanic, 13 percent are black, 8 percent are Asian and 4 percent originate from other ethnic groups. The mean age for teachers is 38 years, with an average of 12 years in the teaching profession, of which 11 years were spent teaching mathematics. Seventy-nine percent of these +PLUS+ teachers have standard credentials while 21 percent have temporary or emergency credentials.

Of the three school districts represented in the collaborative, LAUSD is by far the largest, with 585,000 students. This represents an 11 percent increase in enrollment since 1980 and a 2 percent increase since the 1985-86 school year. Fifty-six percent of the total student population is Hispanic, 18 percent is black, 18 percent is white, 6 percent is Asian and 2 percent is from other ethnic groups.

The LAUSD has forty-nine high schools instructing 126,000 students. Fifty-one percent of the students are Hispanic, 21 percent are white, 17 percent are black, 7 percent are Asian and 4 percent have other ethnic ancestry. Fourteen percent of students in the LAUSD regard English as a second language. Seventeen percent receive AFDC support, and 23 percent are eligible for government subsidized lunches. Twenty-seven percent are LEP students and of these, 89 percent are native Spanish speakers. The dropout rate in the LAUSD was 14 percent for the 1987-88 school year for grades 10, 11, and 12, 4 percent lower than the 1986-87 school year. The average score on the California Assessment Program Test for seniors from the thirteen LAUSD +PLUS+ schools was approximately the 5th percentile for both reading and math, with district averages ranging in the 15th percentile in reading and the 16th percentile in math based on state norms, with a median percentile ranking of 50. However, approximately 47 percent of students in grades 9-12 scored above the national norm in the Comprehensive Test of Basic Skills-Form U. The requirements for graduation in the LAUSD include two years of mathematics.

Of the 30,590 certified staff in the LAUSD, 62 percent are white, 19 percent are black, 10 percent are Hispanic and 7 percent are Asian, with 2 percent accounted for by other ethnic groups. The average age is 44 years, of which 15 have been spent working in education. Ninety-three percent of certified staff have earned at least a bachelor's degree, with 38 percent holding at least a master's degree. Annual earnings averaged approximately $31,000 in 1987-88.

There are 5,500 teachers in the LAUSD high schools. Of these, 67 percent are white, 15 percent are black, 10 percent are Hispanic, 7 percent are Asian and 1 percent are of other ethnic origins. Of the total, 69 percent of high school teachers are members of an active teachers' union (an affiliate of NEA). Contracts were reopened for negotiation in October, 1987 and were due for renewal in June, 1988. Current salaries range from $21,000 to $36,063 per year ($2,298-$4,007 per month).

Approximately 800 high school instructors teach mathematics in the LAUSD. Sixty-eight percent of these are male and 32 percent are female. Sixty-five percent are white, 12 percent are black, 12 percent are Asian, 8 percent are Hispanic and 3 percent come from other minorities. Of the 98 percent who have earned at least a bachelor's degree and the 38 percent who have at least a master's degree, 85 percent are certified to teach mathematics and 15 percent have emergency certification. Eighty percent of math teachers in the LAUSD are tenured.

A new Superintendent and Chief Executive Officer, Dr. Leonard Britton, was appointed and took office in the summer of 1987. Total expenditures by the LAUSD in 1986-87 was $2.9 billion. In the 1987-88 school year, the budget increased to approximately $3.2 billion. Seventy-seven percent of the total budget came from state funding, 11 percent came from local money and 9 percent came from federal sources, while 3 percent originated from outside sources.

Inglewood Unified School District (IUSD) is the second largest school district represented in the Los Angeles collaborative. Morningside High School, a +PLUS+ school, is one of two high schools in a district serving approximately 16,000 students. The student population has increased 2 percent from the 1985-86 school year and 12 percent since 1980. Of the total number of students in the district, 58 percent are black, 38 percent are Hispanic, 3 percent are white and 1 percent originate from other ethnic groups. Twenty-three percent of the student population are LEP students. Of these, approximately 97 percent speak Spanish as their native language. The dropout rate for grades 10-12 for the 1985-86 school year was 10 percent.

Of the 703 certified staff in the IUSD, 46 percent are black, 44 percent are white, 6 percent are Hispanic, 3 percent are Asian and 1 percent come from other ethnic origins. Twenty-seven percent are males and 73 percent are females. The average age of certified staff is 41 years, of which an average of 15 were spent working in education. All certified staff have achieved at least a bachelor's degree, and 17 percent have earned at least a master's degree. The average salary per year for certified staff was approximately $30,000 in 1987-88.

Of the 1,400 students enrolled in Morningside High School, 720 (51 percent) are males and 680 (49 percent) are females. Seventy percent are black, 29 percent are Hispanic and 1 percent are from other ethnic groups. Approximately 18 percent of the student population speak English as a second language. Thirty-eight percent of student families receive AFDC support. Although the dropout rate is 45 percent, cumulative over four years, approximately 60 percent of graduates go on to post-secondary education. The average score for Morningside High School seniors on the California Program Assessment Test ranged in the 9th percentile in reading and the 4th percentile in math compared to state norms with a median percentile rank of 50.

Seventy-three teachers (42 male and 31 female) serve the student population at Morningside High School. Fifty-six percent of teachers are black, 42 percent are white, 1 percent are Hispanic, and 1 percent are Asian. Ten of these teach mathematics. Of the nine men and one woman, seven are white and three are black. Six have earned at least a master's degree and all have at least a bachelor's degree. All are certified and tenured.

The annual budget of the IUSD is approximately $49 million. Roughly 82 percent of total revenue comes from the state, 13 percent is generated locally, and approximately 6 percent comes from federal reserves. Approximately $270,000 (0.6 percent) is brought in from outside sources.

Recently, the superintendent of the IUSD resigned, leaving the district with a $4.17 million deficit. This represents 9 percent of the total budget. Approximately $2 million of this deficit will be forwarded to the 1988-89 school year budget.

The third school district with a +PLUS+ school is the El Monte Union High School District (EMUHSD). Mountain View High School, the district's only +PLUS+ school, is one of four high schools serving about 8,000 students. The student population has increased 2 percent since the 1985-86 school year and 14 percent since 1980. Of the total number of students, 69 percent are Hispanic, 20 percent are white, 8 percent are Asian, 1 percent are black and 2 percent originate from other ethnic groups. Twenty-four percent are LEP students; of these, 80 percent are native Spanish speakers. The dropout rate for the EMUHSD for the 1985-86 school year was approximately 11 percent for grades 10, 11, and 12. The average score on the California Assessment Program Test for Mountain View High School seniors approximated the 14th percentile in reading and the 23rd percentile in mathematics based on state norms with a median percentile rank of 50.

Four hundred and four certified staff (57 percent male and 43 percent female) are employed by the EMUHSD. Of these, 74 percent are white, 19 percent are Hispanic, 4 percent are Asian and 2 percent are black with 1 percent coming from other minorities. Their average age is 43 years, of which an average of 15 years were spent working in the field of education. Ninety-five percent of all certified staff have earned at least a bachelor's degree and 48 percent have earned a master's degree. Their average salary is approximately $33,000 per year.

The total budget for the 1986-87 school year was $28 million. Of this, approximately 80 percent originates from state money, 14 percent from local revenue and 5 percent from federal sources, while about $400,000 (1.4 percent) comes from outside sources.

As can be gathered from these demographics, major problems facing schools in Los Angeles county include overcrowding, integration issues, and language barriers. Even if the problems of poverty, violence and drug abuse were eliminated, school and county officials would still be hard pressed to meet the educational needs of all students. The formation of collaboratives such as the +PLUS+ program, therefore, is particularly crucial in that it provides teachers with an arena for the development and communication of strategies for overcoming these obstacles and for creating novel and exciting instructional procedures in order to more effectively educate students.

C. Development of the Collaborative

The Urban Math/Science Collaborative is operated by the Los Angeles Educational Partnership and its Board of Directors. Peggy Funkhouser is the Executive Director of LAEP and as such is the director of the Urban Math/Science Collaborative. The Urban Math/Science Committee is an advisory committee to the Board and the policy maker for its three mathematics and science components. The components in 1987-88 were the Model Technology Project (K-12), Professional Links with Urban Schools (+PLUS+) program, and Target Science for K-12. Programs available to both +PLUS+ and Target Science are Industry Initiatives in Science and Mathematics Education (IISME) and Televenture. The Urban Math/Science Committee consisted of fifty-seven members, including nine teachers from +PLUS+ schools, twelve administrators and supervisors from school districts (LAUSD, LA County, El Monte, Pasadena Unified, and Inglewood), eighteen from institutions of higher education, fourteen from businesses and industries, and four from community organizations. Erwin Tomash continued to be the chairman of the Committee. Mr. Tomash is a retired electrical engineer, chairman of the executive committee for Dataproducts Corporation, and a LAEP board member. The Committee met only once during the year, on March 23, 1988 at the California Museum of Science and Industry to hear an update on its programs and a presentation on the Science Connection. This program, sponsored by Southern California Edison, the Jet Propulsion Laboratory and the National Aeronautics and Space Administration, includes a mobile, high technology classroom that visits schools in Southern California. In addition to its members, twenty-four guests, primarily from local industries, were invited to attend. A total of twenty-four people did attend.

The +PLUS+ Program has four parts: the Teachers' Council, workshop series, Teacher Associate Pairs (TAP), and department planning grants. Toby Bornstein is the +PLUS+ Project Director. She is assisted by a full-time administrative assistant, Debbie Novick. Members of +PLUS+ are teachers from the mathematics departments that apply and receive a +PLUS+ grant, teachers who attend the +PLUS+ workshop series, and business and higher education associates. The on-site observer is Richard Curci, a high school mathematics and mentor teacher.

In the beginning of the 1987-88 school year, there were seven +PLUS+ schools: Wilson, Franklin, Jordan, Venice and Washington Preparatory High Schools from LAUSD; Mountain View from El Monte Unified School District; and Morningside from Inglewood School District. In total, ninety-four mathematics teachers from these seven schools were involved. Each department worked during the spring, 1987 to develop its action plan, which was reviewed in June, 1987 and awarded on October 5. To qualify for the $2,500 grant, the school districts had to commit to providing five substitute days to be shared by teachers in the department and professional expert pay to implement their plan. As a result of the +PLUS+ departmental grants, one department increased students' awareness of the applications of mathematics; another department doubled the enrollment of students in Algebra I; a third department increased the sharing of materials among teachers by converting a closet into a mathematics office; a fourth department developed a peer tutoring program on Saturdays used by 200 students; a fifth department purchased computers and developed a classroom management system for keeping student records; and two other departments purchased staff development resources to increase teachers' use of technology in their classrooms.

Teachers' Council

The Teachers' Council continued to evolve during the school year, meeting nearly every month. Each +PLUS+ department is represented on the Council. Other +PLUS+

teachers and resource people are invited to attend the meetings. At its seven meetings during the year, attendance ranged from eight to seventeen with an average attendance of twelve. The Council spent time during the year defining its role and planning the permanent structure of the collaborative. At an early meeting during the year, Mr. Tomash, Chairman of the UM/S Committee, advised the Council that to become credible it needed a series of small successes. At subsequent meetings, the group reviewed current and upcoming activities and continued to refine its structure. One of the tasks the Council was given by LAEP was to decide how best to identify recipients of the Jaime Escalante Teacher award. Teachers accepted this challenge and viewed it as indication that the group has a definite role to play. One teacher noted, "The criteria for the Jaime Escalante award has me stumped. Nevertheless, we have to come up with it. Being in charge of this award will give us even more clout." Another issued raised was how to increase the use of Televenture.

In helping define what part of the current +PLUS+ program should be retained in its permanent structure, the Council agreed that the workshop series is critical to the program's success. In March, the group devoted its meeting to selling the workshop idea to administrators from four districts. Teachers made the presentations, which included a video of teachers' reactions to the workshop. The meeting was a positive event in that it suggested to the Council that it can have an impact. One teacher commented, "Tonight I felt like we can make a difference as teachers. The key is to be organized and communicate." Another teacher was pleased with what the group had been able to accomplish. "Can you believe how far we have come? The New Directions in Math workshop was the most inspiring thing I ever did. I am glad the district people could hear that." Toward the end of the year, the Council's attention was devoted to long-range planning and the discussion of a model for the collaborative involving eight clusters of schools, each with its own Teachers' Council. Important to this model is the participation of parents, the development of expertise at each site so that resources can be shared across schools, and the ability of teachers to function as researchers, specialists, and leaders.

Over the year the Teachers' Council became the central body for +PLUS+ and was the group that took the initiative to make things happen. By the end of the year, the Teachers' Council was a very motivated, task-oriented group with a vision. This was summarized by the on-site observer, "Each member is realizing the importance of the Council and that permanence is not an easy transition. Things are going to move very fast so they (the Council) agreed to meet during the summer."

Addition of New +PLUS+ Departments

On January 7, 1988, teachers from secondary mathematics departments in Los Angeles, Inglewood, Pasadena Unified and El Monte Union High School districts were invited to attend an informational meeting on +PLUS+ and to obtain forms for applying. From the fifty-three targeted high schools, thirty teachers attended, representing nineteen high schools. One teacher commented on the evening, "+PLUS+ sounds like an incredible program. Listening to all those teachers sounds as if we could use a dose of +PLUS+." One of the teachers from a current +PLUS+ department reflected on the process, "One good thing about +PLUS+ was the grant-writing process itself. It helped crystalize our ideas and develop department collaboration." In addition to this meeting, complete application packets were sent to department chairs. In order to be selected as a new +PLUS+ department, 60 percent of the members of a department (including the chairperson) had to agree to participate in the development of the school's Action Plan, a proposal for a $2,500 grant that detailed the department's activities for the coming school year. Furthermore, the entire department had to endorse the programs outlined in the plan.

Mathematics departments from nine high schools, one from Inglewood and the others from LAUSD, submitted applications by the January 29 deadline. All but one of the applications were accepted. The one that did not meet the criteria was rejected because of lack of administrative commitment. This department was encouraged to attempt a small project to build cohesion and administrative support and to reapply in future rounds. The new +PLUS+ departments included 118 teachers from the following high schools: Bell, Belmont, Crenshaw, Dorsey, Fremont, Huntington Park, Sylmar, and University. Bell, Belmont and Huntington Park high schools are year-round schools with three tiers of teachers. Asked what was of greatest importance, the departments most often indicated that departmental organization and communication were top priorities, followed by curriculum reform. One department indicated that sharing instructional resources was important as well. The team from Sylmar chose not to implement its plans; in seven of the departments actually followed through on the process.

A planning meeting for the new +PLUS+ departments was held on March 19, from 8:30 a.m. to 12:30 p.m., at the Northrop Corporation. The meeting was designed to allow the departments to begin to develop their action plans and to meet members from the other +PLUS+ departments. Teachers received a $50 stipend for attending and were provided breakfast and lunch. The planning session was directed by consultants Judy Johnson and Dick Cone. Teachers from the existing +PLUS+ departments were used as small group facilitators in sessions on problems of math content/instruction; identifying problem areas by department; problem-solving strategies; using problem-solving strategies to generate solutions; and how to develop a proposal. For teachers new to the process, the meeting helped to start departments working together. "In my ten years of teaching, I don't think I've ever spent as much time with my department members. . . . Communication means progress." For the facilitator and director who went through the same process the previous year, the meeting also was a success. The director commented, "Things are running smoother. It's a good feeling."

After the first planning meeting, the +PLUS+ director made site visits to each of the new +PLUS+ departments. A second planning meeting was held April 30 at Hughes Aircraft headquarters, located at Marina del Rey at Westchester. This meeting was attended by approximately eighty people, including seventy-five teachers from all eight of the new +PLUS+ departments, as well as the +PLUS+ director and teachers from existing +PLUS+ departments who served as facilitators. The new +PLUS+ departments shared their proposals with one another and received comments. One of the facilitators noted afterwards, "It was exciting seeing the departments all fired up about their plan. Just like [my department] was. I hope they can keep the momentum going." A teacher from one of the new +PLUS+ departments expressed, "This was a great experience. We learned from each other. Our proposal needed to be improved. I agree with the suggestions we received."

A five-member proposal review committee--Richard Curci, Margaret Shoukry, Dick Cone, Jeff Newman (TRW), and Toby Bornstein--met May 23 to make recommendations to each school in each of three areas: goal focus, implementation and evaluation. This group provided input to the new departments to help them improve their proposals.

On June 9, 1988, seven of the new +PLUS+ departments presented their final proposals at a meeting at Belmont High School. A representative of each school presented his or her department's proposal. Fifty teachers and school administrators attended the event. The process of developing a plan continued to foster more open communication within departments. One teacher observed, "The amount of communication in our department used to be zero. We are now talking and we have already gotten our money's worth from +PLUS+, even if we never see a dime." Another added, "When we applied for +PLUS+, we had two problems--attendance and achievement. Already, in the short time we have been addressing these issues, as our proposal reflects."

Department Action Plans

The eight new schools identified specific problems during the March 19 planning meeting that were used as the basis for developing the department action plans. Problem areas identified included the preparation of students, appropriate placement of students, department cohesiveness and group planning, uniform standards for tests and textbooks, and motivation of students. In constructing their departmental plans, the teachers from the eight schools concentrated on affecting student achievement. Approaches under consideration included the proper placement of students, the development of student assessment tools, the integration of new teaching strategies, improved access to student math achievement records, using student motivation and achievement techniques, setting departmental standards and teacher accountability, and the infusion of technology into the mathematics program.

Permanence

Through the year, the UM/S Collaborative considered its plans for the future. The Teachers' Council, as noted above, spent a considerable amount of its meeting time during the year discussing issues and the structure of the organization. One of the main issues facing the collaborative was that of scale. By the end of the 1987-88 school year, fifteen of the sixty eligible high schools had participated in the +PLUS+ department program. At least one teacher from thirty-seven of the high schools attended the workshop series during 1987-88. In general, one teacher would attend from each non-+PLUS+ department. In total, 327 teachers have participated in some aspects of the +PLUS+ over its three years of existence. This number includes all of the teachers of sixteen mathematics departments in seventy-nine secondary schools in twelve school districts within Los Angeles County. This left a number of eligible teachers in the second largest school district still not involved.

In addition to the Teachers' Council, the executive director of LAEP identified a Planning for Permanence Task Force. This group included those who will provide resources, both human and financial, to expand +PLUS+. The Task Force was made up of representatives of the LAEP Board of Directors, LAUSD, the Teachers' Council, the UM/SC, and LAEP staff. These people initially met in different groups to help determine the interest in expanding +PLUS+ and in pursuing a state of permanence. At the end of February and the beginning of March, Barbara Scott Nelson of the Ford Foundation spent time in Los Angeles helping to communicate her expectations for expanding the collaborative and meeting with important people to help make this happen. On this visit, Dr. Nelson met with, on separate occasions, the LAEP Board of Directors, Superintendent Britton, representatives of the Parsons Foundation, representatives from ARCO, and the full LAEP Board. On April 15, the LAEP Board met and gave its approval to the plan for expansion of the collaborative.

On May 24, 1988, the Task Force met in its entirety at the LAEP office to review the plan and to discuss ways to obtain the school board's support for the new proposal. Of the eighteen who formed the Task Force, sixteen teachers, administrators, and other collaborative members attended. The agenda included the workshops and +PLUS+ teachers' release time. Time was set aside during the meeting to allow the participants to get acquainted with one another. One teacher commented afterwards, "This meeting was a first. I believe they heard what we said and are willing to support us. The superintendent was here and this is what he wants." An assistant superintendent noted, "Many teachers think we don't do a thing at the district office but we have some successful programs. This meeting was an eye opener for both sides." The director was encouraged, "This was a success; at first, it was touch and go. We finally got to a common ground. The big job is getting the school board to see it from the teachers' viewpoint. The teachers here had valuable input." An outcome of the meeting was that the three-year plan would be presented to the LAUSD Board of Education and its Education Development Committee on June 9, 1988. Superintendent Britton supported the concept of developing +PLUS+ departments as compatible with his focus on school-based management.

At the June 9 meeting of the Education Development Committee of the LAUSD Board of Education, Ms. Bornstein and two teachers from the Council, Mr. Walters and Mr. Curci, presented the three-year plan for +PLUS+ and asked for an allocation of $900,000. The Board was receptive to the proposal, but wanted some hard data on how the program was affecting student enrollment and test scores. This information was compiled by the project director and sent to the LAUSD Assistant Superintendent for Instruction. The plan eventually was approved by the LAUSD in August as a part of the School Board's auxiliary budget.

D. Project Activities

During the 1987-88 school year, the Los Angeles Urban Mathematics/Science Collaborative's +PLUS+ project sponsored activities for teachers from the sixty secondary schools in the four targeted school districts, and teachers from other school districts as space allowed, and provided a variety of opportunities for professional growth for the fifteen +PLUS+ departments. In addition, +PLUS+ supported activities designed by each individual +PLUS+ department as part of its Action Plan, as described in the section "Development of the Collaborative."

+PLUS+ Workshop Series

Perhaps the most significant effort of the +PLUS+ project during the 1987-88 school year involved the second +PLUS+ Workshop Series. As in 1986-87, the series consisted of four monthly Saturday morning content workshops geared to update knowledge and demonstrate applications and simulations from the world of work, with emphasis on the strands of the California Mathematics Framework. The workshops are planned, and in some cases actually conducted, by teams of teachers working with colleagues from industrial and university communities. The workshops are administrated by teacher coordinators, who also are responsible for ensuring that workshop ideas are field-tested and that the results are shared. The coordinators are either Teachers' Council members or participants in prior workshops who wish to assume a leadership role. Coordinators are trained in cooperative learning techniques to facilitate discussions about field-tested ideas and to encourage the exchange of teaching strategies. They meet after each session to evaluate and to assess progress towards workshop goals.

This year, eight different workshops were held over a period of four Saturday mornings: November 21, December 12, January 23 and February 27. Workshop topics included: Exploring Science with Mathematical Modeling, Probability and Statistics, EQUALS (a training program with a special focus on attracting and retaining women and minorities in mathematics), Geometric Supposer, Software for the Mathematics Classroom, "This Is Your Life" (consumer topics), Calculator as a Teaching Tool in Basic Math, and New Directions in Mathematics (fair division, game theory).

The workshops were designed to provide teachers with opportunities to observe, develop, evaluate and integrate new materials and methods into their mathematics programs and to encourage them to assume responsibility for change. During the weeks between workshops, participants practiced and applied the new ideas and methods in their own classrooms and reported their results at the following sessions. With the exception of the November workshop, which began with an orientation, each of the sessions opened with an opportunity for participants to share field-tested ideas.

Workshop activities included strategies for translating new information into classroom use and for creating and field-testing lessons and instructional materials.

Each workshop participant developed a Teacher Resource Book for his or her own use. These books included ideas, field-tested lessons, work sheets, lists of material resources, bibliographies and lists of guest speakers. The producer of the best field-tested idea from each of the eight workshops received a $200 professional development grant. These ideas will be published in a collection of "+PLUS+ Workshop Field-Tested Ideas."

Registration for the second +PLUS+ Workshop Series was extraordinarily high. While secondary mathematics teachers in the Los Angeles area traditionally have not attended workshops, ninety-nine teachers representing fifty-three schools from twelve districts participated in the series--double the number in 1986-87. As in the first +PLUS+ Workshop Series, participants earned one salary-point credit from the Los Angeles Unified School District, or professional expert pay of $150, one-half paid by LAUM/SC and one-half contributed by the teacher's school district.

Planning Meetings

An initial planning meeting was held in July, 1987, to prepare for the second +PLUS+ Workshop Series. Coordinators and presenters then worked independently over the summer to refine workshop plans. The Workshop Steering Committee felt strongly that the meetings were productive and that, overall, the workshop series is valuable. They indicated that they had benefitted greatly from last year's experience and reported that planning the workshops was easier and more efficient this year. The on-site reporter said, "It seems this workshop series is an arena for teachers who have attended other conferences to share what they have learned with local teachers. It serves as a great follow-up and creates a larger math community. I see the organizers of these conferences being delighted to have their hard work being spread throughout the math community. It's a great showplace to keep the math energy flowing."

Teacher Coordinator Training Session

On September 11, 1987, teacher coordinators attended a training session to help them better understand their role and responsibilities in the upcoming workshop series, and to provide them with strategies for conducting feedback sessions and small-group discussions. Robin Gostin, a mathematics teacher at Fairfax High School, directed the training session, which was held at the LAEP office. Ms. Gostin is a promotor of cooperative learning. The eight teacher coordinators who attended reported that the meeting was very worthwhile and would be useful to them in their role as coordinators.

The on-site observer said, "This was well organized and very helpful for teachers old and new to the teacher coordinator role. They now have a focus on their part in the fall workshops." One teacher said, "I'm sure glad I came. It seems we needed her [Robin Gostin's] input. I wasn't sure about this teacher coordinator role. I feel more comfortable." Another added, "Her [Robin Gostin's] presentation was well organized and helpful to my understanding of my role as teacher coordinator." A third said, "This is much better than last year. I really didn't know what was expected of me. Now I have a clearer picture and some ideas to make it work."

Meeting of Teacher Coordinators and Workshop Presenters

On October 15, 1987, an open discussion on the workshops was held at Wilson High School, site of the workshops, for the teacher coordinators and presenters to review a list of those enrolled and their backgrounds, and to finalize the logistics. Nineteen workshop presenters and teacher coordinators attended.

After the discussion, the participants seemed to feel very comfortable and enthusiastic about the upcoming workshop series. One teacher commented, "Potentially, this could be one of the best math workshop series this year. We certainly have the best people presenting." Another added, "Our teachers can and will do a great job. This year, we have more to offer and we are more experienced." A third said, "We've come a long way from last year. Seems we've got it down. This meeting cleared up any questions I had." A fourth teacher added, "This year's [workshop series] will be an even bigger success. Toby [+PLUS+ Director Toby Bornstein] said we went from seven responses this time last year to forty and still climbing. That's progress."

November 21 Workshop

The November 21 workshop was very well received, although attendance was not as great as had been anticipated. A total of seventy-six teachers attended the eight sessions, approximately fifteen fewer than expected. Overall, teachers rated the November workshop 3.7 on a 4-point scale. Evaluations for individual sessions ranged from 2.9 to 4.0, with two of the eight sessions receiving the perfect 4.0 rating. One teacher commented, "Our session was super and over quickly. The group didn't need much help to start and didn't want to stop. We discussed how we could teach with various software programs. Overall, a good session." One of the presenters said, "I thought things went well. I wish I had more people. Six isn't very large and it was hard to work in groups." The on-site observer said, "This year's workshop series began much better, and was more organized and well managed. I wish more participants could have come." Toby Bornstein, the +PLUS+ Project Director, said "Things are so much better this year. All the sessions went well."

December 12 Workshop

Seventy-eight teachers participated in the December 12 workshop. Overall, the rating for the December workshop was 3.62 on a 4-point scale. Teachers' comments were very positive. The participants were pleased with the usefulness of the information they received, and the opportunity to interact with their colleagues. One teacher commented, "I learned new ideas to share with my students. The examples were practical and useful. The time went by too fast." Another said, "I really didn't want to come, I had Christmas shopping to do. But I'm glad I came. I learned and obtained useful information to take back. I am impressed with this series of workshops." Another teacher noted, "[The presenter] was asking the groups to do something . . . the teachers had to interact to accomplish the goal. At first I didn't know how it would go over. It turned out beautifully. I'm glad I was there."

January 23 Workshop

The January 23 workshop was attended by sixty-five teachers. Although attendance was down slightly, enthusiasm was very high. Overall, teachers rated the workshop 3.68 on the 4-point scale, with the ratings for individual sessions ranging from 3.3 to 4.0 Teachers were very positive in their evaluations and, in particular, seemed to value the opportunity to share ideas with one another. A few teachers reported experiencing problems in identifying appropriate opportunities for field-testing ideas. The +PLUS+ project director reported, "Seems like all the workshops are going well. Sharing is at a high level. Everyone understands their obligation." One teacher commented, "The thing I like the most is the sharing in the beginning. I like hearing what other teachers are doing in their classrooms." Another teacher said, "We are getting so much good information here. I have been using it in my class and it has made a difference. These workshops have been first class." A third said, "We get lots of hands-on materials that I have been using in my class." One workshop presenter from Hughes Aircraft said, "I enjoy working with the teachers. So much sharing takes place. I'm glad to be a part of this."

February 27 Workshop

Seventy-three teachers attended the February 27 workshop, rating it 3.81 on a 4-point scale. The teachers were overwhelmingly positive about this final workshop and about the series as a whole. They reported that they gained a great deal of practical knowledge and that they were able to apply it to their teaching. One teacher commented, "The thing that made these workshops different was that they were run and designed by classroom teachers. Also we got to try out new ideas, bring them back and discuss how well they went." Another said, "I got so much useful material and met some helpful teachers. Working with other teachers has been the most exciting thing for me." A third teacher said, "I now feel comfortable using the Geometric Supposer, thanks to Alan Amundsen. That workshop has opened my eyes to using technology in the classroom." Another teacher said, "These workshops have been the best. I want these workshops to continue next year." The workshop series also seemed to impact upon some of the presenters. A representative from Hughes Aircraft said, "These workshops have changed my mind about teachers. I never knew how many variables they had to deal with and still teach. I have seen some outstanding teachers in my workshop and they have all my respect."

Workshop Assessment Meeting

On April 21, 1988, eleven teacher presenters and coordinators met at the LAEP office to assess the 1987-88 +PLUS+ Workshop Series and to make recommendations for 1988-89. The coordinators seemed to feel that the workshop series was very successful, and that the overall format should be maintained. They did offer some suggestions about ways to improve the workshops, such as changing the presenter for one of the workshop topics and adding a second presenter to another workshop to express a different viewpoint. Ideas for workshop extensions also were discussed, as well as suggestions for involving teachers from the new +PLUS+ schools in the 1988-89 series. It was also agreed that next year the planning committee will consider establishing a minimum enrollment for each workshop topic and will make an effort to ensure that teachers and presenters attend all four workshops. The on-site observer said, "This review process gave the coordinators full ownership and validation that what they did was successful. They were in full control and had good suggestions for improvement." One teacher commented, "I really feel that the workshops are important and spending this time to improve them is worth it." Another teacher coordinator said, "We needed to take a good look at these workshops. We now have a reputation to uphold. Evaluating our performance keeps us fresh." A third teacher added, "I fully agree in keeping things the same for next year. We have a formula that works. The discussion today was needed so we can maintain the quality."

The +PLUS+ project director praised the teacher coordinators for their efforts in the workshop series. She said, "These coordinators have done an outstanding job. They make it work. They are the key."

Retreats

+PLUS+ sponsored two retreats during the 1987-88 school year. Teachers from each +PLUS+ department were invited to attend both events, and business representatives also were invited in the spring.

Fall Retreat

The fall retreat was held October 31, 1987, at the Kellogg West Continuing Education Center on the campus of California State Polytechnic University at Pomona. Thirty-three +PLUS+ teachers representing all seven +PLUS+ departments participated. Also in attendance were +PLUS+ Project Director Toby Bornstein, and LAEP consultants Judy Johnson and Dick Cone. The retreat began Saturday morning with breakfast, followed by a welcome from Toby Bornstein. From 9-10:30 a.m., and again from 10:45-noon, teachers attended teacher-led workshops designed to offer a mixture of classroom expertise and group interaction. Session topics included: Technology in the Classroom, Reward Systems, Student Assessment and Placement, Motivating for Interest in Mathematics, Improving Inter-Departmental Communication, and Managing Student Data. Each participant was able to attend two of the six workshops. After lunch, individual department meetings were held, followed by sessions, "Getting Involved in Policy Decision Making--the Teachers' Council" and "What's New with CAP Testing." Toby Bornstein then offered closing comments. The retreat ended with a wine-and-cheese reception.

Participants were enthusiastic about the value of the conference, rating it 8.12 on a 10-point scale. They described the workshop sessions as "provocative," "enjoyable" and "well-planned." Conference attendees also reported that they appreciated the opportunity to meet in individual departments. At these meetings, they were encouraged to apply the "positive and specific" ideas from the morning sessions to the unique situations in their own schools. One teacher commented, "I had lunch with my department and that's more time spent with them than I had spent in the past five years. We had many things to say. I like them even more and we got something accomplished. We made plans to team teach and set up a teacher workshop." Another said, "In the meetings by department, we aired many problems and found many solutions for our school. In the other sessions, I learned about how to better deal with my math lab and new resources." A third teacher added, "Both morning sessions were valuable. It's interesting to see +PLUS+ grads sharing experiences and offering ideas and suggestions."

The +PLUS+ project director was pleased with the outcome of the retreat. She said, "It's great seeing these teachers in leadership roles. They do an outstanding job."

Spring Retreat

The spring retreat was held May 20-21, 1988, at the Kellogg West Conference Center on the California State University campus in Pomona. Approximately fifty people participated, including thirty-eight teachers from six of the seven +PLUS+ departments, several members of the LAEP staff, two representatives from business, and one from the county. The retreat was designed to offer +PLUS+ participants an opportunity to reflect on the impact that being a part of +PLUS+ has had on each department and also to help the departments plan for the future.

The retreat opened with dinner on Friday evening, followed by departmental meetings to address the question, "What has +PLUS+ meant to us?" During breakfast on Saturday morning, each department had an opportunity to make a presentation. Teachers spent most of Saturday working in small groups addressing the topics "Collecting Our Thoughts" and "Developing A Plan." During lunch on Saturday, a teacher carrying a crystal ball was used to stimulate a discussion on "Teaching Math in the Year 2000." Teachers met in departments again on late Saturday afternoon to discuss "Where do we go from here?" The retreat concluded Saturday evening with dinner and a discussion on the role of the Teachers' Council.

Evaluations of the retreat were very positive. The teachers appreciated the opportunity to meet with their own departments as well as to network with teachers from other +PLUS+ departments. One teacher commented, "We got a lot accomplished last night. The most important part was getting our whole department here." Another said, "We talked about our department. It was a wonderful learning experience.

Sharing ideas and listening to others, we are picking up ideas. . . . I wish more of our department came."

The representatives from business were very enthusiastic about the impact of +PLUS+. A representative from Hughes Aircraft said, "+PLUS+ blossomed into a group that gets things done. Education has got to be #1 priority in this country. Get the noisemakers on your side." A representative from Northrop Corporation added, "When I was involved three years ago, people were standoffish. Now people are more comfortable with me and their roles. +PLUS+ has benefits like bringing people together."

The on-site observer said, "The retreat was a very successful and uniting experience. The math community is alive, friendly and willing to get things done. I wish all departments were there 100 percent. The participants enjoyed being there."

Teacher Associate Pairs (TAP) Program

The Teacher Associate Pairs (TAP) program was initiated during the 1986-87 school year to foster meaningful interaction between high school mathematics teachers and mathematics professionals in the world of work. The program began as an experiment that paired Hughes Aircraft retirees with +PLUS+ teachers to identify appropriate topics and effective forms of interaction between teachers and practicing mathematicians in the "real world." An initial meeting of teachers and retirees resulted in frequent telephone conversations among participants, and a "buddy system" soon evolved. Additional Hughes retirees and active employees volunteered, and a meaningful link in the school-industry network was forged.

During the 1987-88 school year, TRW employees joined the TAP project. This expanding interaction between teachers and other mathematics professionals is beginning to help mathematics come alive in the classroom and to contribute significantly to the growing knowledge pool of +PLUS+ teachers. The program's goal is to establish a widening network of TAP associates accessible to all +PLUS+ teachers, with 100 teacher participants in TAP by 1991.

IISME (Industry Initiatives in Science and Mathematics Education)

Initiated in the summer of 1987, IISME enables secondary mathematics and science teachers to apply for salaried positions in industry during the summer months. These teachers work with industry peers to model today's science and mathematics applications and research for classroom use.

During the summer of 1987, LAEP's pilot program provided seven teachers (including four from +PLUS+ departments) with the opportunity to work in industry. Their positions involved data analysis, artificial intelligence in the teaching of music composition, spectrum analysis of elemental impurities, quality control of data from laboratory experiments, development of general and specific training guides, and staff training. Twenty-five positions in industry have been secured for teachers for the summer of 1988, and industries are conducting interviews of teacher applicants.

Televenture

During the 1987-88 school year, +PLUS+ arranged for all seven +PLUS+ departments to receive modems and telephone lines to link into the electronic bulletin board Televenture. This telecommunication system offers the ninety-four teachers at the seven sites the opportunity to exchange information as well as to participate in forums on critical issues affecting mathematics teachers. A contest held in spring, 1988, to encourage all the teachers to get on-line was very successful.

In addition to the +PLUS+ teachers, several science teachers and district instructional specialists joined the network during the school year, and all TAP associates are being encouraged to participate in Televenture. Plans are underway to extend Televenture in the coming school year to include the eight new +PLUS+ departments and to establish an independent Televenture network for the nineteen Target Science schools.

National Conferences and Workshops

During the 1987-88 school year, +PLUS+ sponsored teachers' attendance at a variety of national conferences and workshops as a means of fostering their interest in new ideas and in revitalizing their professional associations. For example, nine teachers who produced the best field-tested ideas from the second +PLUS+ Workshop Series each received a $200 grant to attend a conference of his or her choice. In many cases, districts have furnished substitute time to allow teachers to capitalize on these special opportunities for training and professional development.

Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy

In June, 1987, the LAUM/SC provided funding for one teacher from each of the seven +PLUS+ departments to attend a conference on computers in secondary school mathematics. The conference, held at Phillips Exeter Academy in New Hampshire, focused on the impact and application of the computer in the curriculum and provided teachers hands-on experience with computer software. Other topics included discrete mathematics, new developments in mathematics, and issues in mathematics education. Transportation, lodging and meals were provided by the collaborative for six of the teachers and by the UMC Technical Assistance Project for one of the teachers. Two of the teachers made a presentation about their experiences at the California Mathematics Council Southern Section Meeting in November, 1987.

In June, 1988, the collaborative funded two +PLUS+ teachers, Yvonne Russell from Mountain View High School and Kathy Blackwood from Venice High School, to attend the Exeter Computer Conference. One teacher commented on the experience, "[Exeter] stimulated my interest in technology and in new directions for mathematics education across the country. . . . I had a chance to expand my vision." The other teacher noted, "It was fun to work with math content and to talk with people who enjoy math."

Math/Science Technology Institute

Seven +PLUS+ teachers from two of the +PLUS+ departments, Mountain View and Venice, applied to attend the Mathematics Science Technology Institute at Berkeley from July 6-31, 1987. Being part of the collaborative helped all of them to get selected. The institute explored the use of technology, including videos, computers and laser discs, in the classroom.

The +PLUS+ teachers who participated in the institute were extremely positive about their experiences. One teacher commented, "MSTI was a class act and the amount of information we received was astounding. I never used computers in my classroom; now I will and feel comfortable and excited about it. I met some very bright and intelligent people." Another added, "A strength of MSTI was that the material shown to us can and should be used in the classroom. Another strength was the sharing that I saw among all the teachers." Another participant said, "Thank you for adding that extra special dimension to an exceptional educational experience." Another teacher said, "When I think of Berkeley, I get MSTI eyed. Seriously, I enjoyed and learned every minute I was there. The institute was well-organized." The on-site observer said, "Many motivated, talented, intelligent and friendly teachers had an opportunity to exchange ideas and share in an extremely rich and well-organized educational experience. The MSTI institute was very, very successful."

North Carolina School of Science and Mathematics (NCSSM) Workshop

The Mathematics Department at the North Carolina School of Science and Mathematics (NCSSM), working with a grant from the Carnegie Corporation of New York, is developing a syllabus for fourth-year college preparatory mathematics. The syllabus is commonly viewed as representative of future trends in mathematics education. NSF has funded a teacher-training model in which teachers assume a leadership role in instructing others in the use of the new syllabus.

Four +PLUS+ teachers received funding from the UMC Technical Assistance Project to attend the training session, "An Introduction to College Mathematics" in North Carolina from July 6-July 17, 1987. Topics included geometric probability, functions, exponential and logarithmic functions, trigonometry functions, matrices statistics, modeling and data analysis. Presenters emphasized the value of using software to provide students with experiences in applied mathematics that typically would be inaccessible to them. Problem-solving strategies were suggested as a means of enlivening manipulative aspects of the traditional fourth-year course. Course materials assumed that an instructor would have only one computer (512K) and one large monitor to use with a class.

In one workshop, the participants were required to make presentations to both large and small groups in preparation for the interactive in-service they each would give to teachers in their home districts. The four +PLUS+ teachers who attended will conduct a workshop on the NCSSM materials during the third +PLUS+ workshop series during the 1988-89 school year.

Workshop participants reported that it was an extremely worthwhile experience. One teacher commented, "This was the best pre-calculus material I've seen in a long time. I want IBM's now. I'd do it again. NCSSM had a well-run program." Another added, "I enjoyed every minute. There were teachers there from other collaboratives and it made the experience more national than local. This country has great teachers." A third teacher said, "I learned and learned and learned. . . . NCSSM was a growth experience for me." Another commented, "I'm glad I went. We were treated with respect and the people at NCSSM were organized. I liked the materials they presented but I need IBM computers." The on-site observer noted that as a result of the workshop, some of the teachers are discussing the possibility of writing grants for IBM computers.

Conference Follow-Up Meeting

On August 4, 1987, five +PLUS+ teachers and Toby Bornstein met at one of the teacher's homes to discuss their experiences at MSTI, and the Exeter and NCSSM workshops. The teachers were eager to talk about what they had learned at the conferences. One teacher commented, "I liked NCSSM very much. It was very valuable and I enjoyed it. I'll try very hard to use what I learned. I'm glad I went; it was worthwhile." Another said, "We are putting together a proposal for IBM and that's what we have to do. I believe in the software I saw at NCSSM. I need IBMs so I can spread the word. The other institute also sounded fascinating." Another teacher added, "I found it interesting to hear what the other programs had to offer. In fact, Exeter and NCSSM teachers got to use some of the same software." Another teacher said, "Next year I want to attend all of the institutes." The +PLUS+ Project Director was very pleased with the teachers' enthusiasm. "The teachers are taking the initiative to write a grant for computers, and speak at conferences," she said. "We have come a long way."

CMC Southern Section Conference

On November 13-14, 1987, the California Mathematics Council held its annual conference for Southern California in Long Beach. Eleven teachers who have been active in +PLUS+ made presentations at the meeting. One teacher reported, "It was a pleasure to speak in front of adults for a change. I was glad to be at the conference because I learned valuable information that could be used in the classroom. Conferences for math teachers are essential for professional development."

National Council of Teachers of Mathematics (NCTM) Annual Meeting

Six +PLUS+ teachers representing six +PLUS+ departments and the project director received funding to attend the annual meeting of the National Council of Teachers of Mathematics in Chicago, Illinois, April 5-9, 1988. Four teachers were given funds from +PLUS+ for both travel and expenses. The teachers also were granted release time by the school district. In addition, one teacher's expenses were paid for by the UMC Technical Assistance Project for making a presentation at one of the Technical Assistance Project's workshops, and the on-site observer's expenses were paid for by the Documentation Project. One teacher noted the quality of the presenting and the variety of material available.

Mathematics Reform/Teacher Professionalism Conference

Three +PLUS+ teachers and the +PLUS+ project director attended the Mathematics Reform and Teacher Professionalism Conference at the North Carolina School of Science and Mathematics in Durham, North Carolina on June 23-24, 1988. The expenses for one teacher and the director were funded by +PLUS+, the expenses for one teacher were funded by the UMC Technical Assistance Project, and the expenses and a stipend for one teacher, who was a presenter, were funded by the Technical Assistance Project. The conference was designed to inform and guide the broader mathematics community in its effort to improve mathematics education at the precollege level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. The conference focused on helping educators to understand the need for change in mathematics education and develop strategies for bringing about the change. One teacher commented on the conference, "I was astounded at the fact that the idea that teachers can be leaders in their own profession was new to so many people."

E. Observations

Project Management

The +PLUS+ program is coordinated by a small central administration and a very active Teachers' Council. Ms. Bornstein, with the help of a full-time assistant, has played a key role in planning and coordinating activities, attending to details, maintaining open lines of communication, and overseeing day-to-day project operations. The Teachers' Council continues to evolve and has assumed increasing responsibility for decision making and for promoting the program to the school district administration and the Board of Education. This year, for example, the Teachers' Council decided to continue the workshops, developed criteria for the Jaime Escalante Mathematics Teaching Awards, and provided ongoing leadership to departmental teams joining +PLUS+.

The collaborative's central administration is supported by the executive director of the LAEP, Ms. Funkhouser, who is influential at the policy level and is responsible for acquiring both the administrative and financial resources that the program needs to function. This strong support system allows the director to devote her time to program issues. The executive director and project director have a positive working relationship and do not maintain strict lines of authority or responsibility. This flexibility was evident, for example, when Ms. Bornstein assumed an active role in making policy decisions related to expanding the program and planning for permanence.

The advisory committee, perceived by many as the core of the collaborative, does not play a significant decision-making role. Instead, the committee's fifty-seven members serve as a pool of readily available help and energy. In addition, committee members work to generate interest and support for +PLUS+, both among their colleagues and in the broader mathematics community. In 1987-88, for example, nearly twenty committee members were appointed to a task force charged with developing a plan for expanding the +PLUS+ program to all LAUSD high schools and for acquiring the district superintendent's support. Such interaction and cooperative effort is made possible by committee members' willingness to accept an assigned task and follow it through to completion.

The +PLUS+ management structure reflects the program's team-building approach, in which a limited number of departments have been selected, associate pairs have been developed, and workshops have been conducted for a larger group of teachers with the single intent of affecting the teaching of mathematics in Los Angeles secondary school classrooms. A strong central administration has been important, at least initially, to help teachers within a department interact as a team, to offer encouragement until the teams become self-motivated, and to provide the links among the different departments as the teams pursue their own directions. Because the project director is not affiliated with the district, she is able to serve as a facilitator who can intercede as needed between the district and the teams to remove institutional barriers to the teams' goals.

As the number of +PLUS+ teams increased, the need for an organizational link among them became evident. The Teachers' Council was established to meet this need. Council members serve as representatives of and messengers for their own teams, and have also helped teachers from the newly enrolled departments in the planning process. In some respects, members of the Teachers' Council have assumed some of the functions formerly performed by Ms. Bornstein. It is this organizational structure--a group of departmental teams, each represented on a common Teachers' Council--that will serve as the model by which the +PLUS+ program will be expanded to all secondary schools in the LAUSD.

Several aspects of the Teachers' Council/departmental team model merit further consideration. In many cases, this approach has fostered networking, collegiality and leadership among the teachers currently involved in it. The question remains, however, as to whether the model will work to support or encourage the development of meaningful professional relationships among teachers, business people, and those from higher education. The Teacher Associate Pairs (TAP) program has experienced some success in promoting interaction between teachers and business people. The project director is involved initially in helping create the pairs and arranging for Televenture, but it is then left to the departmental teams to maintain a relationship that meets their needs; it appears as though individual departments may not be exerting the necessary energy to ensure that the partnership continues. At one school, for example, business associates were invited to make presentations in June, 1987, on the application of mathematics. The teachers have not initiated any further contact with their associates since that date. One teacher commented that he missed the department's interaction with its associates and that he was certain the associates would be willing to participate further but that no one had yet taken the initiative to make another contact. This raises some questions about the TAP program's management needs. Is it sufficient for the departmental teams to be assigned the responsibility of maintaining communication and contact with their associates? Would it be more effective if the Teachers' Council were to maintain this program? Or should another group, comprised of both teachers and mathematics users from business and higher education, be established to assume this responsibility? The TAP remains in the earliest stages of its development, with only two companies and a limited number of teachers currently involved. But if a widening network of associates is made accessible to all +PLUS+ teachers, an administrative structure will be necessary if the program is to survive.

Communication issues seem to have been resolved adequately during the year. The Teachers' Council, with a representative from each of the department teams, was an effective conduit through which information could be disseminated to teachers at those schools. Their increased participation in collaborative workshops suggests that teachers are staying informed about upcoming events. Televenture, with all +PLUS+ teachers enrolled, is being used to the extent that teachers are communicating with one another. In previous years, the collaborative distributed announcements to schools from eleven school districts. This year, to alleviate the work load, information was sent only to the four districts in which schools have +PLUS+ departmental teams.

Collaboration

The +PLUS+ program has been effective in reducing teachers' sense of professional isolation and in increasing interaction, both within departments and between schools. Several activities have contributed to this networking, including departmental team building, the Teachers' Council, and the workshops. The planning process was new to some teachers; as one reported, "Planning together with my department was a new experience." Collegiality among teachers within a school is growing and is beginning to affect even some teachers who were initially hesitant about change. One teacher commented, "Originally we wanted the department in close proximity, but teachers didn't want to move. They now want greater collaboration. Teachers are coming out of classes more during lunch and break to discuss math." Teachers are also becoming acquainted with their colleagues from other schools and, for a few, from other parts of the country. One teacher noted, "+PLUS+ has given us a vehicle to meet with other teachers. In 20 years of teaching, I didn't know teachers at other schools. Now I know over 100 mathematics teachers throughout the USA." Another teacher commented, "We have interacted with other schools and have had a good cross-fertilization of ideas."

Several teachers have also had opportunities to interact with people from industry and higher education, through involvement on workshop steering committees, as co-presenters at the workshops, and through the TAP program. In addition, four +PLUS+ teachers had summer internships through IISME. Because representatives of higher education have been involved in the collaborative primarily as workshop presenters, only those teachers in attendance at a particular session will have had the opportunity to discuss mathematics with these academicians. As a result, many +PLUS+ teachers feel that they have had some interaction with those from business and industry, but very little with people from higher education. Asked how the collaborative has fostered relationships with those from the other sectors, a teacher responded, "None with business other than having a retiree from Hughes help as a tutor. There has been nothing with higher education." Another teacher noted that the +PLUS+ workshop he/she attended had also involved people from business and industry, but not those from colleges or universities. One teacher expressed her view of the situation: "+PLUS+ hasn't helped to develop relationships with those from higher education other than a phone call. Nothing substantial. It takes work to foster those relationships. They don't have lots in common with high school teachers."

Thus, it appears that collaboration has taken a variety of forms and has occurred with varying degrees of success. Relationships between teachers and those from higher education and business have developed, but they can be characterized as isolated instances rather than as networks of professional support. A more common occurrence has been the development of professional relationships between teachers; in this sense the strategy of team building among teachers within a department has been successful. Televenture has helped some teachers to expand a supportive network to include teachers at other +PLUS+ schools. Clearly the collaborative has helped to change the ways teachers relate to one another. As one teacher said, "[The collaborative] has made me feel part of a community. It has broken down the isolation."

Professionalism

As a result of their collaborative involvement, teachers have experienced an enhanced sense of professional empowerment and status. They have attended more professional meetings, learned more about mathematics, and have become more willing to take professional risks. In addition to the benefits of the planning and team-building processes, teachers have benefitted from the +PLUS+ grants and the ability to use them to affect their working lives. In some cases, the money has been used to develop and implement a curriculum project that surpasses or enhances the content required by district mandates. One department publicized the ways mathematics is used in a variety of jobs; another allowed all ninth grade students to begin the year in Algebra I; a third established a student peer-tutoring project. Other departments used the grants to purchase equipment, such as a copier, software, a video projection unit, and a computer management system to maintain records. The department grants have been a viable strategy in that they require teachers to work together to write the grant proposal and then provide resources through which teachers acquire autonomy, as well as the means for affecting their working conditions. As one teacher said, "[+PLUS+] has given us a focal point for planning together. . . ."

Teachers who have been active in +PLUS+ report on a change in their attitude toward teaching and a renewed sense that they can affect their working conditions. One teacher said that the most significant change that can be attributed to the collaborative was empowerment: "We can affect our conditions." Another teacher cited an improvement in department morale. This change in attitude toward teaching and strengthened sense of empowerment can be attributed, at least in part, to the improved status teachers and departments are experiencing as a result of their +PLUS+ involvement. "The program has given our department prestige and clout on campus," reported a teacher. A department chair reported that he/she had gained personal prestige because of his/her new-found ability to secure and administer grants. Another teacher reported that, "[The department chair] is more respected in the district. We as a department can speak to other schools that are considered our extended department."

Their participation in +PLUS+ activities has instilled in teachers a new confidence and willingness to try new ideas. One teacher observed, "[+PLUS+] has expanded the way we see ourselves. I am aware of more things that can be done." Another teacher reported, "I have more control over my existence and I've expanded the limits of what I do." A third teacher commented, "[Plus] has given me a license to take risks in my class and to use technology more than ever in my career." Other teachers are trying new technology, such as the Geometric Supposer, in ways they would never have anticipated. One teacher credits +PLUS+ with informing him about the Geometric Supposer and a summer conference in Berkeley. After his experience there, he gained the confidence to try new approaches to teaching geometry, including requiring students to develop their own textbook.

The teachers who have experienced the greatest change are those who have been involved in the program's departmental component. But the project also provides opportunities for other teachers to hear about +PLUS+, and it encourages other departments to join. One teacher who had attended the Saturday workshops and a meeting sponsored by +PLUS+ departments to explain the program's benefits tried to convince her department to join. She described +PLUS+ goals as fostering networks among teachers and as empowering teachers to make decisions. She went on to say that the program is reducing teachers' isolation and enhancing their sense of professionalism. This is one indication that teachers who have not been involved with the departmental component of +PLUS+ nonetheless have acquired an accurate perception of the program's purpose.

Of key importance to the teachers who have been active in +PLUS+ have been the opportunities to attend workshops, conferences, meetings, and institutes in order to refresh their knowledge of mathematics and its applications. In this context, +PLUS+ has served as an important impetus in increasing teachers' professional activities and in bringing teachers together to share ideas and information. Asked about the most significant changes that can be attributed to the collaborative, five of ten teachers indicated that the conferences they had attended were of great value. Many of the others stressed the importance of conferences. For one teacher, the collaborative provided the motivation to join professional organizations: "I am going to join LACTMA and CMC for the first time in 20 years. I used to ignore them. This year I spoke at two [conferences]."

Since the collaborative's inception, there has been a noticeable increase in the activity and spirit of the mathematics teachers who have been involved. The on-site observer noted, "The math community is getting to know one another and +PLUS+ teachers are represented everywhere. I couldn't say that a year ago." One mathematics teacher accompanied the superintendent to a conference to make a joint presentation. Another teacher's work was described in a *Los Angeles Times* article. Several teachers have been presenters at professional meetings. All of these developments suggest a new sense of professionalism and an atmosphere of change among the teachers of mathematics in LA.

Mathematics Focus

The collaborative's mathematics focus continues to be related to the +PLUS+ Workshop Series, which in 1987-88 was influenced by the *California Mathematics Framework*. Within this general structure, the workshops covered a range of issues, including consumer topics, use of software, mathematical modeling, and discrete mathematics. Because the workshops are used as a forum through which teachers can share the knowledge they have acquired at special conferences or other events, the workshop topics are determined largely by those teachers who have attended national conferences, such as those at Exeter or NCSSM. Departmental grants also provide resources to address the specific concerns of an individual department, such as algebra enrollment and the use of computers. As a result of these activities, +PLUS+ teachers are expressing a greater awareness of current and proposed trends in mathematics. All five teachers who were asked whether their awareness of the current trends in mathematics education nationwide increased as a result of the collaborative responded affirmatively.

The workshops have motivated teachers to test new approaches and then to make long-term changes. Teachers are asked to field-test an idea that has been introduced in one meeting and then to describe its success or failure at a later meeting. Teachers are also increasing their use of technology, including more applications of mathematics, and developing new courses. One teacher reported, "We have been more structured to get everyone involved in technology." Another teacher reported incorporating new ideas from the framework and from his/her enhanced understanding of technology. A third teacher said that students are learning more about the applications of mathematics, and another reported that she had initiated a finite mathematics class as a result of attending the workshops. Such a course was being developed at two schools, and a finite mathematics forum was developed on Televenture so that teachers from the two schools could communicate with one another. Other teachers are actively involved in using the Geometric Supposer, as well as testing other new ideas.

Some +PLUS+ teachers have been active in the geometry forum on Common Ground and are communicating with their peers from around the country. The LA teachers have asked for suggestions about difficulties they have had in using the Geometric Supposer, and have reported their progress with the software. The forum itself allows teachers to talk mathematics and to check with one another about teaching concerns. A sample of their dialogue helps illustrate how the +PLUS+ workshops are affecting teaching: "At a Supposer workshop . . . I learned about the function that allows us to square things on the Supposer. I brought that information back to class. One of the groups had been experimenting with triangles, other than right triangles, to see if they could locate any other relationships. I gave them my new knowledge and with it they discovered the relationship of the sum of squares of the two shorter sides of a triangle and the longest side in acute triangles and in obtuse triangles."

Of key importance is that, through the array of activities that +PLUS+ supports, some mathematics teachers are becoming more involved in their teaching and in current trends in mathematics education. They are testing more ideas and taking more risks. They have become more interested in the California Framework, in applications, and in technology. Some teachers have used this new knowledge and interest to change what they do in the classroom. An important consideration is that much of this change occurs when teachers help other teachers.

F. Next Steps

The Los Angeles Math/Science Collaborative will continue to support teacher professionalism and teacher-initiated changes and reforms. Over the next three years, the collaborative plans to increase +PLUS+ activities to achieve district-wide impact in the Los Angeles Unified School District; to increase the implementation of the *California Mathematics Framework* in Los Angeles; and to design a permanent framework to sustain secondary mathematics teacher-directed professional development. After the three-year expansion, +PLUS+ will to reach from 800 to 1,000 teachers in more than 100 schools.

Five major new programs are planned. A new Resource Teacher position will be created. Teachers with an expertise in a particular area of mathematics or approach to teaching will train other teachers. Also planned are classroom demonstrations for teachers to observe effective use of teaching strategies with students, followed by discussions with the demonstrating teacher. Jaime Escalante Mathematics Teachers Awards will be granted to secondary public school mathematics teachers. Finally, an annual +PLUS+ Conference will be held in Spring, 1989.

The Teachers' Council, the central administrative body of the +PLUS+ program, will be supported and strengthened during the next three years to become the key element in a permanent teacher-directed school-based management system in mathematics. By increasing its membership, the Teachers' Council will increase the number of teachers involved in the decision-making process.

A new standing Math/Science/Technology Committee for the LAEP Board will replace the Urban Mathematics/Science Collaborative and will meet three to four times a year to focus on revitalizing mathematics and science education and to identify resources to meet teachers' needs. The collaborative then will consist of those on the mailing list, including teachers, business associates, higher education associates, and others.

During the next three years, +PLUS+ plans to facilitate departmental planning training for fifteen new departments each year. This would result in a total of sixty-one +PLUS+ departments trained by June, 1991. Each new department will be eligible for +PLUS+ grants of up to $2,500 for implementing its program.

The Los Angeles Math/Science Collaborative will continue to offer a series of eight teacher workshops. Special efforts will be made to involve representatives from the business community. Grants will be awarded to fund workshops designed to develop ways to integrate associates' ideas into the mathematics curriculum. In August, the collaborative will sponsor thirty teachers to attend the Woodrow Wilson Institute.

IISME will continue to be developed and extended as a means of increasing the number of teacher internships. TAP (Teacher Associate Pairs) business associates will assist with the development and presentation of the +PLUS+ workshops in 1988, as well as interact with teachers through Televenture to exchange curriculum ideas and strategies, identify and share resources, and collectively identify new needs for the consideration of the Math/Science/Technology Committee.

+PLUS+ will continue to offer professional development opportunities for teachers to attend local, regional and national conferences, in particular UMC-sponsored national institutes and those recommended by the Education Development Center (EDC).

SUMMARY REPORT:
MEMPHIS URBAN MATHEMATICS COLLABORATIVE

by the

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Memphis Urban Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Memphis Urban League; documents and interview information provided by the project staff; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM Conference in Chicago in April, 1988; survey data provided by teachers; and three site visits by the staff of the Documentation Project.

MEMPHIS URBAN MATHEMATICS COLLABORATIVE

A. Purpose

As stated in the funding proposal submitted to the Ford Foundation, the primary goal of the Memphis Urban Mathematics Collaborative is to promote an environment of professionalism for mathematics teachers and to assist them in broadening their horizons; to establish creative working relationships between mathematics teachers and other professionals in colleges and universities, and in business and industry; and to develop creative projects that will result in teachers' improved abilities to relate mathematical concepts to students from a practical perspective.

B. Context

The Memphis metropolitan city limits encompass a population of approximately 650,000 persons. Fifty-three percent of Memphis residents are white and 47 percent are black. As one of the fastest growing urban areas in the nation, Memphis has been flooded by an influx of new business development, a trend that has in large part offset the economic impact of the recent closing of a large Sears distribution center which had employed 1,100 workers.

In October, 1987, construction was initiated on a multimillion dollar Navy testing center in Memphis. The center, a test laboratory for large-scale ship and submarine models, is expected to create hundreds of jobs, thereby stimulating growth in local service industries.

The Memphis City Schools (MCS) district consists of 153 schools. In addition to schools with standard curricula, there are twenty-two magnet schools in the district. Secondary magnet schools are classified into four categories: 1) international studies; 2) college preparatory; 3) health sciences and engineering; and 4) creative and performing arts. Elementary magnet schools are classified as 1) enriched academics; 2) open education; 3) fundamentals; 4) Montessori; and 5) individually guided instruction.

Approximately 108,000 students were enrolled in the MCS district in 1987-88. Fifty-one percent of the student population is male and 49 percent is female. Seventy-eight percent of public school students are black and 22 percent are white. By district policy, students are categorized solely into these two ethnic groups.

Less than one percent of the student population has English as a foreign language. Forty-nine percent of MCS students are in government-funded lunch programs.

In 1972, as Memphis initiated the court-ordered desegregation of its school system, more than one-third of city students transferred to private schools. Since then, the availability of Optional (Magnet) programs has reduced the number of city students attending private schools to the current level of 22 percent.

In total, 586 students attend the only MCS middle school (grades 5-8), and 26,610 students attend twenty-three MCS junior highs (grades 6-8, 7-8, or 7-9). Approximately 51 percent of these students are male and 49 percent are female. Seventy-nine percent of the middle/junior high school student population is black and 21 percent is white. Forty-six percent participate in federally funded lunch programs.

Memphis has fifteen senior high schools (grades 9-12 or 10-12) and fourteen junior/senior high schools (grades 7-12), with a combined enrollment of 22,000. Fifty-two percent of the high school student population is female and 48 percent is male. Approximately 77 percent of the students are black, and 23 percent are white. Sixteen percent are eligible for federally funded lunch programs. Thirteen percent of MCS high school students dropped out during the 1986-87 school year. The district's drop-out rate is computed by subtracting the number of students enrolled at the end of the year from the total enrolled at the beginning of the year. Those who are known to have enrolled in other districts are excluded from this figure.

Approximately 16,000 Memphis public high school students enroll in mathematics courses each year. Graduation requirements include two units of mathematics from among the following courses: high school arithmetic, Algebra I, Algebra II, Geometry, Pre-Algebra, and Applied Mathematics. In addition, students who meet course prerequisites can take Trigonometry, Advanced Algebra, Advanced Math Survey, and Calculus.

In April, 1988, approximately 37 percent of MCS seventh-grade students scored at or above the 50th percentile, based on national norms, on the Stanford Achievement Test.

The MCS district employs 2,402 high school teachers; approximately 63 percent are women and 37 percent are men. The number of black teachers approximately equals the number of white teachers. High school teachers' salaries range from $18,000 per year for instructors with a BS degree and no prior teaching experience, to $36,000 for instructors with a Ph.D. and 25 years of experience. An additional $7,000 per year can be earned through the Tennessee Teacher Career Ladder Program.

The Career Ladder Program involves three experience/salary levels. By taking tests and submitting to evaluation of their classroom teaching, teachers can progress to a higher pay level. Level 1 teachers must have at least four years teaching experience and must pass the State Career Ladder Test; in return, they receive a $1,000 bonus per 10-month contract. Level 1 teachers with nine years of experience can reach Level 2 status after evaluation by two state-designated evaluators, the principal, a district mathematics supervisor and one class of students selected by the teacher. Level 2 teachers receive a bonus of $2,000 per year for a ten-month contract, and can receive an additional $2,000 if they work an additional month. Level 2 teachers with thirteen years of experience can reach Level 3 by submitting to further evaluation procedures in return for an additional $3,000 for a ten-month contract, and an extra $2,000 for an eleven-month contract, or $4,000 for a twelve-month contract.

Approximately 60 percent of MCS high school teachers are members of the local affiliate of the National Education Association (NEA). All MCS teachers receive five in-service days and five administrative days per year for professional development.

The MCS district employs approximately 350 mathematics teachers. Sixty-four percent are women and 36 percent are men. Approximately 52 percent are black and 48 percent are white. Fifty-two percent of high school mathematics instructors hold a master's degree, and all have earned at least a bachelor's degree. Of the total, 314 are certified to teach mathematics. However, not all math-certified instructors teach mathematics courses; as a result, approximately 90 percent of those teaching mathematics are certified. Eighty-one percent of certified math teachers are tenured.

Dr. W. W. Herenton has been superintendent of the MCS system since 1979. In 1988, Dr. Herenton was one of ten national winners of the Horatio Alger Award. This honor is bestowed upon role models who have gone from "rags-to-riches." Dr. Herenton, who grew up in a two-room apartment in Memphis' housing projects, became the city's first black superintendent in 1979.

The 1987-88 district budget totalled $292 million, a 7 percent increase over 1986. Approximately 51 percent of the system's total revenues come from local sources, 45 percent from state monies, 2 percent from federal sources, and 2 percent from outside revenues. A 4-cent tax shift that was recently approved will contribute about $1.75 million to the city and county schools for the 1987-88 school year.

In 1988, Memphis City Schools ranked fifteenth in size and thirty-sixth in spending among the country's forty-four largest school systems. In addition, a study by the University of Chicago rated Memphis schools among the most segregated in the South. The average black student in the MCS district attends a school that is only 18 percent white.

One of the major concerns facing the MCS district is the poor physical condition of many of the city's older schools. It has been suggested that the most dilapidated buildings should be torn down rather than renovated, and that several new buildings should be constructed. Even with this new construction, the district would experience a net loss of six schools, a cutback that would save an estimated $10 millon.

Another major concern facing MCS teachers is a recent ruling by Superintendent Herenton that all Career Ladder 2 and 3 teachers who opted for the extended contract would have to teach one month of the 1988 summer school. Teachers are concerned that such enrichment activities as SAT and ACT preparatory sessions and tutorial programs will be eliminated if teachers must spend the extra month teaching summer school classes.

Avron Fogelman, a local real-estate developer, established a multimillion dollar scholarship program in 1987-88 to allow low-income students to attend Memphis State University. To qualify for a scholarship, students must maintain a 2.75 grade point average in grades 9-12, and must stay clear of drug abuse and other illegal activities. Recipients must also come from homes with incomes of $15,000 per year or less. Further, applicants must show that they do not expect to receive substantial financial aid from any other source; Mr. Fogelman, however, will pay the difference for those students who can get some scholarship money but not enough to cover the total costs of their tuition. Estimated tuition for the first year of the program will total $6.46 million.

Another issue facing Memphis educators is a sharp rise in the crime rate in public schools. During 1986-87, nearly 400 weapons were confiscated in Memphis city schools, an increase of 17 percent over the number of weapons confiscated during 1985-86.

C. Development of the Collaborative

The Memphis Urban Mathematics Collaborative continues to be managed by its director, Herman Ewing, the Chief Executive Officer of the Urban League, and its coordinator, Nancy Gates, a Memphis mathematics teacher on leave during 1987-88. Mr. Ewing is responsible for coordinating the project's efforts with the Ford Foundation, the larger UMC community, the Memphis Board of Education, and the consultants to MUMC. Ms. Gates, who devotes 60 percent of her time to the collaborative, implements program objectives and takes care to remain visible and accessible to district mathematics teachers. During the school year, Mr. Ewing and Ms. Gates met every Thursday for purposes of planning and coordinating. Fatima Durham, a recent graduate of Christian Brothers' College and a graduate of Northside High School, assumed the position of administrative assistant to Ms. Gates in September, 1987. Rita Ross, a high school mathematics teacher, is the on-site observer.

The Memphis Urban Mathematics Collaborative is comprised of and receives support from the Memphis City Schools; five universities and community colleges; and approximately twenty-two corporations, businesses, and public agencies. Seven additional businesses provide indirect support that may include support of individuals' time and expertise, but not financial contributions.

The Memphis Urban League is the funding agency for the collaborative. As described by its Chief Executive Officer, the Memphis Urban League Executive Committee agreed to be the collaborative's host agency for four reasons: mathematics can help students become better thinkers; the League has experience in administrating and organizing programs; the League has a strong record in organizing people to establish new projects; and the League has connections and good rapport with many school principals. The Urban League's experience and expertise, combined with its long-term commitment to raising the academic achievement of black students, made it an ideal host agency.

During the 1986-87 school year, the collaborative targeted the mathematics teachers in twenty schools (thirteen high schools, five junior high schools, and two grades 7-12 schools). The approximately 150 mathematics teachers from these schools became collaborative members by volunteering to sign a registration form. At the school district's in-service prior to the beginning of the 1987-88 school year, members of the collaborative Advisory Board operated a booth to answer questions about the collaborative and to encourage teachers to join. Teachers from all fifty-three schools with students in grades 7-12 were eligible to register. As an incentive for joining the collaborative, the district agreed to grant all collaborative teachers two additional staff development days each semester. At the end of the in-service day, 180 mathematics teachers had registered to join. During the year, the number of teachers climbed to 205, or nearly 60 percent of all eligible mathematics teachers in the district, and fifty-five more than the previous year. Approximately 100 of the teachers are considered active in the collaborative; thirty are considered very active. The 205 teachers who registered to join, in combination with the fifty resource people and the twenty speakers from higher education and business who agreed to participate, comprised the collaborative membership during 1987-88.

At the end of 1986-87, a working group was established to facilitate open communication among key representatives of the district, the Memphis Urban League, and the collaborative. Group membership included an assistant superintendent of the Memphis City Schools, the director of optional schools and Ford projects for the district, Mr. Ewing, Ms. Gates, and the chair of the collaborative Advisory Committee. Early in the year, the group met monthly in the assistant superintendent's office. As the year continued, meetings were scheduled less frequently; in total, the group met approximately five times during the year.

During the summer of 1987, the collaborative commissioned an outreach consultant to assist in fund raising. Although this individual established several contacts with some positive results, he was unable to identify or develop a reliable or permanent funding source. The consultant worked for the collaborative for only one month.

Advisory Committee

The Advisory Committee, which is the major decision-making body for the collaborative, met quarterly during the 1987-88 school year. The project's application for continuing support submitted to the Ford Foundation in June, 1987, listed five responsibilities of the committee:

1. To develop program objectives and priorities;
2. To generate public and private support for program priorities and objectives;
3. To monitor adherence to program timetables;
4. To evaluate the program's effectiveness and take corrective action; and
5. To assist in the implementation of program action steps.

Committee membership totalled twenty during the year--seven from higher education, five from business and industry, two from the school district administration, one from the Urban League's Education Committee, and five teachers. Professor Marshall Jones of Rhodes College continued to chair the committee. The three sub-committees identified by the Advisory Committee during 1986-87 to coordinate specific projects were reassigned to more general functions. The new sub-committees included: 1) the Planning Committee, which oversees and plans collaborative programs; 2) the Policy and Nominations Committee, which developed and submitted proposals for policy changes and names for new Advisory Committee members; and 3) the Liaison Committee, which focused on establishing teachers as liaisons between the collaborative and the schools. The Policy and Nominations Committee did not meet during the year.

The Advisory Committee met four times during 1987-88. Attendance at these meetings ranged from eleven to seventeen members, with a near equal distribution of teachers, representatives from higher education, and representatives from business or industry. Also in attendance at nearly all of the meetings was an administrator from the school district. Meeting agendas focused on updating members about collaborative activities; discussing and voting on budget issues; discussing teachers' reactions to collaborative programs; planning; and reacting to other critical issues. Calculus in Memphis high schools was a recurring topic of discussion during the year, as were the benefits and drawbacks of teaching calculus at a lower level than that of the Advanced Placement course.

In May, at the last meeting of the year, Professor Jones announced he was stepping down as chairperson because of his need to focus on other matters during 1988-89. Discussion of possible successors ensued, but the final decision for naming the chair is the responsibility of the Urban League Executive Director. Also at that meeting, two new sub-committees were established that would meet during the summer. The Permanence Committee was charged with developing and considering the future direction of the MUMC and the various components of the permanence proposal, which must be submitted to the Ford Foundation on June 1, 1989. The Advanced Algebra Committee met in June to discuss the curriculum of the new one-year course proposed as an alternative to calculus on the fifth-year level.

Teacher Committee

The Teacher Committee is comprised of fourteen teachers who were identified from among those who registered to join the collaborative and stated a willingness to work on the committee. Its membership reflected Ms. Gates and the collaborative's view of the importance of including a representative mix of teachers in terms of their ethnicity, grade-level and home schools. The committee met four times during 1987-88, with nine to fourteen of its members in attendance. The group's primary task was to brainstorm about projects and programs that the collaborative could offer to teachers and to present those proposals to the Advisory Committee. In addition, the committee provided a core group of active teachers who were willing to become involved in planning and implementing these projects. From the outset, committee members were enthusiastic and optimistic about their involvement; during the year, the committee evolved into a cohesive working group in which ideas were shared freely and input was readily incorporated into the collaborative's activities. At each of the meetings, teachers mentioned the enjoyment they derived from working together.

Project Committee

The Project Committee met three times during the first semester to discuss the recommendations of the Teacher Committee and the implementation of the proposed projects. Project Committee members included two teachers, one representative from the business community, two college professors, and the MUMC coordinator. Six or seven people attended each meeting. At one meeting, the committee established guidelines for selecting the teachers who would receive collaborative support to attend the NCTM Annual Meeting in Chicago. At the following meeting, the committee reviewed the seventeen applications and selected ten teachers to attend.

A number of teachers who are active in the collaborative participate in programs sponsored by the Memphis Area Council of Teachers of Mathematics (MAC-O-TOM), the local NCTM affiliate that meets twice each year. Professor Crabtree, chairperson of the Mathematics Education Department at Memphis State University, is the driving force behind this organization. In large part, MAC-O-TOM's function is to provide opportunities for those interested in the teaching of mathematics to meet together, to hear a speaker, to discuss business, to enjoy refreshments, and to become acquainted. On average, about fifty people attend each event, including elementary and secondary teachers, mathematics education majors at MSU, and others.

D. Project Activities

The Memphis Urban Mathematics Collaborative offered a variety of activities to mathematics teachers during the 1987-88 school year. These activities were designed to promote professionalism and to establish linkages between Memphis mathematics teachers and other mathematics professionals in business and higher education. In addition to the activities sponsored by the collaborative, MUMC supported teachers' attendance at national meetings and workshops.

Local Workshops

Summer Workshops

In response to a teacher survey, the collaborative sponsored a series of four-hour, four-day workshops (a total of sixteen hours in each session) designed to refresh teachers' skills and to introduce innovative ideas about teaching. Topics included algebra, geometry, probability, and mathematics across the curriculum.

Enrollment was limited to twenty teachers in each workshop, with teachers from the twenty target schools given registration priority. All four workshops were filled, with waiting lists of as many as twenty teachers. Participants received a $192 stipend from the collaborative for attending each four-day workshop series.

Mathematics Across the Curriculum workshop. On June 15-18, a workshop focusing on practical applications of mathematics in other fields was presented at the State Technical Institute. Dr. Margie Hobbs and Dr. Cheryl Cleaves provided a survey of the applications of mathematics in the high school curriculum, with particular emphasis on the use of Algebra I, Algebra II, and Geometry in chemistry, physics, the social sciences, and vocational education courses. Nineteen Memphis City Schools mathematics teachers attended. The workshop was well received by participants, most of whom rated it 5 on a 5-point scale. One teacher said, "I feel this workshop broadened my perspective on the use of mathematics in the technological and vocational areas, especially the use of geometry and trigonometry." Another commented, "Kids are always asking what good this [math] will do them. Even if I don't have an application readily available, I know how to research it and find applications."

Probability workshop. On June 15-19, Dr. Marshall Jones of Rhodes College presented a workshop on probability. Nineteen mathematics teachers attended. The workshop included an introduction to intuitive probability, simple finite probability spaces, probability laws and applications, counting problems, and probability distributions. Participants were pleased with the workshop, assigning it ratings of 4 and 5 on a 5-point scale. Those in attendance complimented Dr. Jones' teaching skills and reported that the workshop was very worthwhile. The on-site observer noted that "topics were explained in such a way that all teachers (with varying backgrounds) could understand."

Geometry workshop. On June 23-26, Dr. Tom Caplinger of Memphis State University presented a geometry workshop featuring an overview of major topics, with concentration on algebraic and paragraph-style proofs; three-dimensional concepts and relationships (including derivations of volume and surface area formulas); transformations; and enrichment activities with paper folding, tessellations, and problem solving. Seventeen mathematics teachers attended. While there was some feeling that the workshop focused too much on the "optional" student, the teachers felt they had benefitted from the presentation. One commented, "Dr. Caplinger is very knowledgeable and personable. As far as the topics, I don't believe I could possibly introduce these topics--except tessellations--to students at my school. I was expecting more ways to motivate the average student in geometry--not the optional."

Second-Year Algebra workshop. On July 27-30, Dr. Kenneth Williams of Rhodes College presented a workshop designed to help teachers develop a more unified functional view of algebra. Topics included linear, polynomial, rational, inverse, exponential and logarithmic functions, and techniques in graphing and problem solving. Twenty Memphis City Schools mathematics teachers attended. While some participants thought the workshop was geared toward "optional" students, the evaluation forms were very positive. One teacher commented, "I especially appreciated being reminded of things that I had learned eons ago and had forgotten. I got several ideas about better ways to learn topics than the methods I had been using."

Geometric Supposer Workshop

On August 7, the collaborative presented a Geometric Supposer workshop at the East High computer lab. Dr. Richard Houde, head of the mathematics department at Weston High School in Massachusetts and advisor to Harvard's Educational Technology Center, demonstrated his innovative software program. Twenty-five mathematics teachers attended. The participants praised the speaker and the workshop, but expressed concern that computers are not available in their schools.

Swap Shop Workshop Series

On December 2-4, a series of six workshops was held at the State Technical Institute to provide outstanding teachers in various levels of mathematics teaching an opportunity to work together to collect and document the effective teaching techniques they use in their classrooms. Workshop topics included: Pre-algebra and Algebra I; Algebra II; Geometry; Advanced Math, Trigonometry and Calculus; Seventh and Eighth Grade Mathematics; Ninth Grade and Applied Mathematics.

The workshops were created by teachers for their colleagues. Six collaborative teachers who had attended a training session in November made the presentations, and eighty-four of the ninety-eight teachers who were invited attended at least one session. Throughout the planning and implementation stages, the collaborative played a facilitating role, assisting the teachers as needed. As a result, the workshops were characterized by a free exchange of the problems and challenges facing those who work in the classroom; teachers came away from the events with new ideas about activities that could directly affect students' learning. Comments from teachers were very positive. One said, "I really enjoyed this workshop, it helps me to understand that I am not in this boat alone! We all have the same problems." Another said, "Teachers really need great workshops like these to share strategies. I really picked up on a new and exciting idea to enhance my teaching." Other comments included: "Every teacher needs this opportunity. Excellent overall." "We need to have more workshops of this nature. Great." The MUMC director commented that he had never heard teachers express such care and understanding about the problems of teaching as he did at the workshops.

A series of idea booklets based on the workshops was shared with Memphis City Schools mathematics teachers at a follow-up in-service on January 27. This provided an opportunity for all teachers to take advantage of the rich discussions that occurred at the Swap Shops.

Project TERM

In July, 1987, Project TERM (Teacher Enrichment and Reinforcement in Mathematics), which is funded by the National Science Foundation, worked through the collaborative to encourage Memphis teachers to attend a five-week workshop at LeMoyne-Owen College in Memphis. The project, which included academic year follow-up and support, focused on discrete mathematics and basic programming, as well as problem solving and applications. Projects that related specific mathematics topics to the secondary school classroom were introduced in the workshop and implemented as part of regular teaching assignments during the 1987-88 school year. Each participant received a stipend of $1,000 and six hours of tuition-free undergraduate credit. The workshop was designed for teachers who: 1) were not certified to teach mathematics, 2) did not major in mathematics at the college level, 3) had taught no more than 50 percent of the secondary curriculum, or 4) had no more than five years of mathematics teaching experience. Forty collaborative teachers participated in the workshop.

Project TERM will be offered again during the summer of 1988. In May, 1988, collaborative teachers who had participated in the first session helped establish criteria for teacher selection and guidelines for the curriculum to be presented this year at the 1988 Summer Workshop.

Grant-Writing Workshop

On March 25, 1988, the collaborative sponsored a workshop on grant writing and technical communication. Presented by Brother Edward Doody, Director of Grants and Proposals at Christian Brothers College, the workshop covered procedures in seeking external funding, technical writing, techniques of writing grant proposals, and budget development. The workshop also guided participants through an exercise in writing small grants. The twenty-seven teachers who attended found the workshop very worthwhile. One teacher commented, "It was a worthwhile day. There is a lot of material out there. . . I found several potential proposals. There is [a great deal of] money out there; we have to just write for it!"

National Workshops and Conferences

NCSSM 1987 Summer Workshop

The collaborative sent three teachers to the North Carolina School of Science and Mathematics July 5-17 to attend a pre-calculus curriculum workshop sponsored by the Carnegie Corporation. The course, which stressed an applications approach to the study of pre-calculus, covered six modes of mathematical thought: geometry, data analysis, probability and statistics, mathematical modeling, computers, and finance. The teachers who attended will present workshops for their colleagues who teach Algebra II, Advanced Math and Calculus during the summer of 1988.

Woodrow Wilson Summer Institute

The collaborative provided funds to seven teachers to attend a one-week geometry seminar at Rhodes College, offered as part of the Woodrow Wilson Fellowship program. The seminar was designed to enhance participants' involvement in their own learning and to develop peer support among teachers.

National Council of Teachers of Mathematics Annual Conference

MUMC selected ten Memphis teachers to attend the National Council of Teachers of Mathematics (NCTM) Annual Conference in Chicago, Illinois, April 6-9. The collaborative paid for the teachers' airfare, registration, and hotel accommodations. The teachers, who were selected based on criteria established by the Project Committee, are required to share their experiences and new knowledge with other Memphis teachers at MUMC workshops and in-services during 1988-89.

The teachers who attended the NCTM conference reported that they learned new teaching strategies and techniques, and developed a new awareness of trends in mathematics education. One teacher commented, "I think the experience was worthwhile because it gave me an opportunity to learn what other teachers and professionals are doing in math, and it also let me know we share some of the same concerns in the math education of our children."

Mathematics Reform/Teacher Professionalism Conference

Four MUMC teachers and Collaborative Director Nancy Gates were selected to attend the Mathematics Reform and Teacher Professionalism Conference at the North Carolina School of Science and Mathematics in Durham, North Carolina. The conference, presented June 23-24, 1988, was designed to inform and guide the broader mathematics community in its efforts to improve mathematics at the pre-college level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement.

Dinner Meetings

Resource Associates Dinner

On December 7, the MUMC sponsored a dinner as part of its Resource Associates Program, which was developed to foster one-to-one relationships between teachers and both college/university professors and mathematicians in business and industry. Memphis City School teachers and business/university personnel who were interested in establishing a resource associate relationship were invited to attend. The dinner, held at the Public Eye Restaurant, provided teachers and their associates an opportunity to reach agreement on preliminary plans for the year. Ten mathematics teachers and ten mathematicians from business and industry attended. One teacher commented, "This was great. I'm glad we met. . . . At least we are leaving with concrete plans and we know who is our partner." Another added, "I'm really excited about this project [problems using math in the real world]. If we can get this going, it'll help so many teachers!" A third said, "This is great! I already learned something new in math from my associate. She'll come to my classes and show them. I know they'll love it." A university professor said, "I'm happy to do this. I feel my school has . . . taken a low profile for too long. We need to get out and help in the community and this is a good start."

Pre-Algebra Teachers Dinner

On January 26, the collaborative sponsored a dinner meeting for pre-algebra teachers. Ms. Dorothy Strong, Director of Mathematics for the Chicago Public Schools and originator of the pre-algebra curriculum, addressed the role of pre-algebra in the curriculum, as well as minority achievement in mathematics. Fifteen teachers and five school administrators attended the dinner, which was held at the French Quarter Inn.

The on-site observer commented, "Everyone liked the idea of dinner meetings and was interested in future ones." One teacher commented, "I really thought the speaker was dynamic. She made us aware of teachers' expectations and how these affect how our students perform. . . . She involved all of us in groups; we all discussed our views with one another." Another added, "It was worthwhile. It was nice to get together with other teachers in the same field of study and share some time."

IBM Dinner Symposium

Forty-six teachers and administrators from the Memphis City Schools participated in a March 17 dinner symposium sponsored by IBM Corporation. Dr. Elayne Schulman, a former mathematics teacher who is currently a writer, software developer and consultant for several companies, including IBM, presented the keynote address, "How to Use Technical Teaching Styles and Technical Curriculum." Tom McConnell from the Information Connectivity Department of the Board of Education and Norm Moore from IBM also addressed the group. Breakout sessions included a tour of the IBM Center and a work session on the Geometry and Algebra Tool Kit, mathematics software developed by IBM.

One teacher commented, "I thought the IBM seminar was good. . . . I particularly liked the hands-on. I wish we had longer at the terminals and fewer per terminal. . . . I loved the speaker; she knew her math, was involved and from the math field." Another added, "I thought it was great. I got a lot of new ideas of how to present certain topics. I really enjoyed the hands-on session. I can see a lot of uses for all the new software displayed." An administrator said, "I think the IBM symposium was great. It made teachers aware of new software that is available. It will help them to update their classes and their way of viewing math teaching." Another administrator commented, "I only wish I had more money to spend. The dinner was great and I felt it helped teachers to see the latest trends in teaching math. Any teacher training is helpful."

Year-End Reception

On June 3, the collaborative sponsored a dinner at the Racquet Club for anyone who had participated in an MUMC event during the year. Dan Teague of the North Carolina School of Science and Mathematics spoke on the uses of computers for pre-calculus. Thirty-five people attended, including teachers, school administrators, and representatives from the university and business communities.

One teacher commented, "I thought it was all great. I enjoyed the reception, seeing other teachers and the speaker." A business representative who serves on the Advisory Committee said, "I enjoyed the whole evening. The reception was nice. Teachers were talking with one another. . . ." A Math Supervisor said, "I thought it was excellent; the food was good, teachers were sharing with one another. I thought the speaker was good, concise and delivered the presentation well."

Curriculum Development

Meeting to Discuss the NCTM *Standards*

On March 23, the collaborative and the Memphis City Schools sponsored a discussion of NCTM's proposed *Curriculum and Evaluation Standards* for School Mathematics. Three supervisors and four teachers were invited to attend the meeting, which was held at the Fairview Administrative Annex. All seven participants recommended promoting the new standards; their suggestions for implementation included more teacher training for elementary teachers and modification of standardized tests.

Advanced Algebra Curriculum

A committee comprised of calculus and advanced mathematics teachers from each optional school, and volunteers from the Advisory Committee--including representatives from three colleges and universities and from one business--was established to create a new curriculum for the fourth year of mathematics. The committee met June 20 to brainstorm on the question of whether an alternative to calculus should be offered, the topics that should be covered, their emphases, and an appropriate time frame. Seven of the nine committee members attended; after agreeing that the course was needed, they reviewed a variety of texts and materials.

Summer Internships

The Memphis Urban Mathematics Collaborative successfully identified four teacher internships for the summer of 1987. Teachers worked at the Financing and Accounting Department of the U.S. Army Corps of Engineers; the Budget and Rates, Customer Engineering, and Systems Engineering Departments of Memphis Light, Gas and Water Division; and the Strategies Department of Commerce Investments.

Teachers interested in the internships were required to complete job application forms from the sponsoring organizations, and to participate in interviews initiated by the companies based on an applicant's background, interests and experience. Participating organizations selected their own interns from the pool of teachers they chose to interview and assumed the cost of the intern's salary.

The teachers who participated in the internship program found it a valuable experience. One teacher said, "I think it was very worthwhile. As an intern, I realized what topics should be stressed in order for success in the business world. Much of what should be stressed comes late in the year and is often taught quickly with too little time. My experience helped me to focus better on what should be stressed to help my students succeed." Another said, "The intern program was very worthwhile. I learned that I could do something other than teach. It was a challenge. I learned that teachers are more confined, work harder and aren't really treated as professionals."

On September 17, the collaborative held a dinner for the four summer interns and the collaborative staff. Teachers discussed their summer experiences, highlighting the ways in which their experiences could positively affect their teaching. As an outcome, one of the teachers who participated in the internship program is organizing a committee of ten junior high teachers to collect and develop a set of mathematics problems used in the work place.

In anticipation of a 1988 summer internship program, interested teachers were invited to an organizational meeting on May 30, 1988. Thirteen teachers attended the meeting, which was led by the Urban League training staff. Those in attendance were urged to make presentations to businesses about the collaborative and, in so doing, to encourage businesses to invite them to work as summer interns. Some teachers who attended the meeting came with the expectation that the internships were already arranged. In the following months, eight or nine teachers did visit and discuss the collaborative at three businesses, but no internships were established as a result of the process.

Speakers Bureau

The MUMC has established a Speakers Bureau that offers a list of approximately fifty representatives from universities, businesses and the school system who are willing to speak to mathematics classes and teachers' groups on a variety of topics, ranging from engineering and accounting to the history of mathematics and number theory. In fall, 1987, an updated Speakers Bureau Directory was distributed to all Memphis City Schools mathematics teachers. The directory contains biographical information on each speaker and lists nearly seventy presentations the speakers are willing to make. Teachers are very enthusiastic about the Speakers Bureau. One teacher commented, "I like the whole program and want to use it more." Another said, "I had three speakers.

It was great, everything worked well. I had my students write essays about the speakers and they really enjoyed it."

Collaborative Newsletter

In the fall of 1987, the collaborative published the first issue of its biannual newsletter. *The MUMC Bulletin* was distributed to approximately 250 teachers, as well as to representatives of the business and university communities. The newsletter is an important vehicle for distributing information to collaborative teachers regarding collaborative events, conferences, activities, issues in mathematics and teaching suggestions. M. Scott Prosterman, who was hired part-time for the year through the Urban League, edited the newsletter.

Teacher Initiative Grants

During the 1987-88 school year, the Memphis Public Education Fund once again made Teacher Initiative Grants available to Memphis City Schools teachers. These grants, awarded annually, fund teacher-initiated projects designed to improve instruction; to enhance the teaching-learning process, including fostering teachers' understanding of their subject areas; and to pay teachers' tuition for graduate or undergraduate classes at a college or university. The MUMC does not administer the grants, but it does encourage teachers to apply; in addition, the MUMC coordinator serves on the selection committee. Of the 360 applications that were processed, 150 grants were approved, including fourteen grants to mathematics teachers; for example, three mathematics teachers at one high school applied for and received a large screen computer viewer.

E. Observations

Project Management

Efforts initiated at the end of the 1986-87 school year to develop a more viable administrative structure for the collaborative have worked well. Communication among key participants has been enhanced and administrative support has been strengthened. The increased number and high quality of collaborative-sponsored activities during the past year are evidence of a functional and effective administrative structure. In addition, periodical meetings of the "executive group" at the assistant superintendent's office, and between Mr. Ewing and Ms. Gates have improved communication and have helped to integrate the various management approaches and operating styles of those who provide the collaborative's leadership. These executive meetings also serve to highlight the district's commitment to the collaborative and to its continued success. Finally, the hiring in September of an administrative assistant for the project coordinator helped to relieve the burden of daily record keeping and paperwork and to allow Ms. Gates the opportunity to focus on more substantive issues.

The coordinator, who receives most of her direction from the Advisory Committee and the executive group, has made a smooth transition from classroom teaching to organization and administration. Important to this transition has been the support Ms. Gates receives from those who serve on the Teacher Committee and the Advisory Committee. Through this networking, she has been able to identify teachers willing to help her implement the collaborative's plans. Clearly, Ms. Gates' experience in the school system and her relationship with many of its teachers have helped to facilitate the collaborative's early efforts to become a viable, effective organization.

During the past year, the director has participated in the project's growth and maturation and has adjusted his perspectives in light of what he has learned about collaboration and how it can best be engendered. It has become very important that teachers are very active in the planning and operations of the collaborative. Similarly, personal interaction among teachers and other mathematics professionals is now viewed as essential to the project's success. In addition to serving as the liaison between the collaborative and the Ford Foundation, Mr. Ewing's role has included helping the project coordinator become more knowledgeable about the operations of the League and the ways it can support the collaborative. Finally, Mr. Ewing has been consistently willing to tap into his own network of business and community contacts to help organize collaborative activities. This was particularly true when he volunteered to assume responsibility for locating businesses that would support a teacher intern during the summer. Despite the obvious benefits of Mr. Ewing's efforts, however, questions did arise from other collaborative members who were unsure of the status or progress of his endeavors and were therefore unable to plan or schedule supporting events.

The Advisory Committee serves as the key administrative body of the MUMC. A number of its members are very active in the collaborative and include those from all three sectors. This group has been instrumental in providing direction and focus to the collaborative, while the project coordinator assumes responsibility for the details. Two types of sub-committees have been established: Membership in the first includes only members of the larger committee; an example of this type is the Project Committee. Membership in the second includes primarily those who do not serve on the Advisory Committee; this second type of subcommittee is inherently valuable in that it expands the number of people involved in the decision-making process. This multi-faceted committee structure works well in that some of its groups are task specific and meet as needed to address particular issues, while others gather input from a larger number of collaborative participants. The model currently employed establishes these groups as fairly fixed in their membership, with member replacement occurring on an as-needed basis only. The benefits of this approach are obvious in the cadre of people who are becoming very knowledgeable about the collaborative. A potential problem is that the involved group may be viewed as exclusive and closed to outsiders; at this time there is no indication that this is happening.

Collaboration

The MUMC structure fosters interaction among teachers, business people, and those from higher education. The Advisory Committee provides a forum in which representatives of the three sectors can work together to address issues of concern to them all. The dinner meetings offer opportunities for socializing and professional enrichment. The Speakers Bureau creates situations in which teachers can interact one-on-one with those from business and higher education, and in which these nonschool professionals can directly affect students. The variety of workshops and Swap Shops bring teachers together to learn from one another and to study topics relevant to their work in the classroom. The collaborative--and the collaboration it fosters--are beginning to make a difference in the professionals lives of teachers in the Memphis City Schools.

Teachers are becoming acquainted with their colleagues, both within and across schools. One teacher commented, "I've met more teachers from other schools and universities and have gotten to know them better. I've learned a lot from their sharing and brainstorming with me at meetings." Another teacher reported, "I have become closer to other teachers in the city. [The collaborative] kept me abreast of what they were trying and doing in their classrooms." Interaction with their peers has reduced, and in some cases eliminated, teachers' sense of isolation. "MUMC has made us realize that we are not islands," said one. Teachers have begun to network and to benefit from the ideas shared through this process. One teacher noted that the collaborative had affected daily teaching because a "more varied form of ideas [was] picked up from

MUMC--not just the workshops but also the Teacher Committee meetings when we share with one another."

Another difference is that collaborative teachers have enjoyed greater opportunities to interact with those from business and higher education and, as a result, they are becoming more comfortable in these professional relationships. One teacher commented, "My contacts with others (in other schools, business and higher education) have been tremendous, the highlight of this year. I feel a part of a larger, involved group that wants to improve education." For another teacher, interaction with those from higher education has produced a new understanding: "I . . . have become better acquainted with professors and was surprised to see we all have similar problems and concerns."

A third difference is the relationship that has evolved between the collaborative and the district administration. Ms. Gates and others from the collaborative have been able to support district efforts and to provide extra help as needed; Ms. Gates, for example, is helping to write an advanced mathematics course for the fourth year of mathematics to replace the existing "appreciation" calculus course. The collaborative's summer workshops for secondary teachers have allowed the district mathematics coordinator to focus more of her attention on planning summer activities for elementary teachers. In addition, Ms. Gates serves as a liaison between the district and the teachers, thereby providing ready access to the district administration formerly unavailable to mathematics teachers. As a result, some teachers have received the computer hardware they needed to bring the new teaching methods and ideas they have learned in collaborative activities into the classroom.

Collaboration has not developed without a hitch. The Speakers' Bureau has received mixed reviews and little use. While in some cases, the presentations were successful, in others, they were poorly presented and poorly received. In another case, a last-minute school assembly meant that the scheduled speaker could not meet with the class; the teacher who planned that visit is reluctant to arrange for another speaker. What has emerged from the development of the bureau is that professionals in business and higher education are very willing to come and talk to students about their work. Despite this community cooperation, the success of the Speaker's Bureau is far from certain. It has become clear that the most successful visits have been those in which the speaker and the teacher have been able to meet prior to the speaker's classroom visit and when the school routine is such that the teacher can have more assurance of a consistent schedule. A list of available speakers will be available during 1988-89, but Ms. Gates will coordinate the visits in response to teachers' requests.

Professionalism

Asked about their teaching conditions and their work, Memphis mathematics teachers say they are, for the most part, satisfied with their current status and working conditions. Some teachers comment about the amount of paper work that is required, or about being required to teach both science and mathematics because they hold certifications in each. Teachers appear to take for granted the unavailability of resources, such as computers, in the mathematics classroom; they explain that it is difficult for the mathematics classes to use the computer lab because the English classes are scheduled to use it. Teachers had expressed general acceptance of the Career Ladder Program, until this year when many of the Career Ladder Level III teachers were required by the district to spend their extra hours teaching summer school. This need for an increased summer school staff was generated by a recent mandate that students must pass specific tests to be promoted to the next grade; those who fail are required to enroll in summer school.

Despite mathematics teachers' general acceptance of the status quo, the collaborative appears to be making some difference in how they view themselves, the conditions of teaching, and teaching as a profession. Teachers have begun to experience a stronger sense of professional self-esteem, a new conviction that what they are striving for professionally merits the support of their peers and of the system. The collaborative negotiated with the district, for example, so that collaborative teachers would be granted two release days for staff development each semester. One teacher reported, "Release time has been granted freely for math teachers whereas other disciplines were denied time to attend conventions. I feel we are treated a little more professionally." In addition, opportunities to interact with administrators and Board members have fostered an enhanced sense of professional self-worth. As a significant change attributed to the collaborative, a teacher reported, ". . . the fact that people from the Board (supervisors, assistant superintendents, etc.) have attended some of our activities and recognized us as an important group. I think it has helped improve their opinion of us. . . . " The same kind of support is being exhibited at the school level where, for example, one teacher noted a change in the working conditions as a result of the principal's increased support: "She has been supportive and arranged substitutes willingly." In addition, teachers have begun to experience the benefits of a peer support network, which has been established and fostered through collaborative activities and meetings. One teacher observed, "It has made me feel that as a teacher I do have the power to change things. I used to think I could do nothing to better my class or position. The collaborative offers me and others a support group."

The impact of this enhanced sense of professionalism is being felt in the classroom, where teachers' renewed enthusiasm and interest in their work is generating similar feelings in their students. "I feel really good," said one teacher. "[The collaborative has made a big] difference in how I feel about myself. I used to just teach, now I like what I'm doing and how I feel about myself as a teacher." Another teacher observed that teachers' participation in the collaborative had resulted in changes in students' attitudes toward mathematics. "The students are interested and more willing to work; sixty-nine out of seventy of my students recently passed the Tennessee proficiency test--these are low- and average-level arithmetic students. I think I've been more enthusiastic and willing to grade extra problems, and it has rubbed off on them."

Finally, the collaborative appears to have increased teachers' sense of professional autonomy and their willingness to try new ideas and approaches. Memphis teachers are being exposed to these new ideas at professional meetings and workshops. They are brainstorming and sharing with their colleagues. And they are learning to question the status quo, to ask whether the standard, accepted approach is always the best one. In the words of one teacher, "I feel more involved in decision making that affects math teachers. I feel more like a professional. I think I'm more active rather than just accepting curriculum and situations as they are." Another teacher reported that the collaborative has had a major impact on the practices of daily teaching: "I evaluate daily what I'm going to require; I question more my techniques and what is to be taught. Because of exposure from MUMC, I try to be more aware of new directions for math teachers and don't just follow the book or the way things have always been done. I've also incorporated computers into my classes." Thus, their comments indicate that the Memphis Urban Mathematics Collaborative has made a difference in the professional lives of teachers during its two years of operation. This isn't to suggest that Memphis teachers were generally dissatisfied with their profession prior to their collaborative participation. But it does seem apparent that the collaborative has provided a spark that is generating new ideas and channeling new energy into the teaching of mathematics in Memphis public secondary schools.

The collaborative has established itself as an organization whose sole purpose is the professional betterment of mathematics teachers. As a result, the project has great credibility in its relationships with the school district and with representatives of local business and higher education. In addition, collaborative resources have made it possible for teachers to attend professional meetings for the first time. Finally, the collaborative presents programs and offers new direction for the teaching of mathematics. This has helped mathematics teachers to become acquainted with their peers and to build a new group identification.

Mathematics Focus

The collaborative has presented and supported activities related to a wide range of mathematics topics. In the Swap Shops, teachers focused on courses from general mathematics through calculus and advanced mathematics. Several teachers attended summer workshops on probability, second-year algebra, geometry, a fourth-year college preparatory class, and mathematics applications. Presentation topics during 1987-88 ranged from pre-algebra and the Geometric Supposer to technology in teaching mathematics. The Advisory Committee and Teacher Committee discussed local calculus courses and the issues being debated nationally in regard to those courses. As a result of these experiences, teachers are becoming more aware of national trends in mathematics education and some have become willing to try new things.

One major revelation shared by many collaborative teachers is that the system is more adaptable to change than they had once believed. By mandate, the curriculum must be keyed to state-identified objectives. And, since the district requires students to take the California Achievement Test and some teachers also use the SAT, the curriculum is keyed to the objectives of these tests. Within these constraints, however, there is some flexibility--even though curricular changes must be approved by the district mathematics supervisor. After attending a workshop in North Carolina, for example, one teacher wanted to try new approaches that departed from the approved text. "I have received permission to teach my pre-calculus classes with the Tool Kit and other North Carolina software, rather than just following the text," this teacher reported. As a result of their attendance at national meetings, such as the NCTM Annual meeting, many teachers have gained greater understanding of the curriculum they are required to follow. "Now I understand some changes in the state curriculum," said one. "I see a real need for probability and statistics and can see algebra for everyone."

In addition, collaborative workshops, meetings, and discussions have enhanced many teachers' awareness of current national recommendations for the mathematics curriculum, and for the use of technology in the teaching of mathematics. One teacher reported a change in the way he/she viewed the mathematics curriculum: "I feel more knowledgeable about the [NCTM] *Standards*. I now question some of the things we teach and omit in the curriculum guides, and I was one of the teachers who helped to write the curriculum." Another teacher commented, "I attended NCTM and felt really on top of national trends. I read more and feel more up-to-date on the *Standards* and other classroom teaching models."

Despite these clear examples of the kinds of change the collaborative has fostered, it should be noted that not all Memphis mathematics teachers are fully supportive of new developments and approaches. In one calculus classroom, for example, students are not allowed to use calculators because they cannot be used on the Advanced Placement test. What the collaborative has been able to do is to support discussion and consideration of the mathematics curriculum and to provide programs for teachers to expand their knowledge of the content area.

F. Next Steps

In fall, 1988, the Memphis Urban Mathematics Collaborative will continue its work with the school district. Collaborative teachers will continue to receive four professional days annually to allow their attendance at both local and national conferences and workshops. The collaborative will continue to cover the cost of teachers' travel, tuition, and stipends. The collaborative also will work with the mathematics curriculum coordinator to conduct an in-service program on the NCTM *Standards*. Included in this August program will be a dinner symposium on teacher professionalism and an in-service program on mathematics curriculum reform.

The collaborative plans to pilot Introduction to College Mathematics-Advanced Algebra, an alternative to senior calculus, at two schools. The curriculum, which was written by collaborative members, will include applications, discrete mathematics, modeling, data analysis, computer applications, probability and pre-calculus concepts.

The use of the Geometric Supposer will be expanded from two teachers this year to eight schools during 1988-89. The three teachers who attended the NCSSM Institute in Durham last summer received IBM computers; one of the three plans to modify the curriculum for the Advanced Mathematics course to incorporate the new methods she learned. The other two will use the software and materials without changing the curriculum.

Teachers who attended the Woodrow Wilson Geometry Institute will be examining the role of proofs in geometry from a new perspective and will share their thoughts and ideas with other geometry teachers at a workshop this year.

During the coming year, the hours for the project assistant will increase from 80 percent to full time, to allow the coordinator the time and freedom to teach half time. In addition, the Advisory Committee, Teacher Committee, and the Permanence

Committee will meet regularly to plan activities and to develop a permanent structure for the collaborative.

SUMMARY REPORT:
NEW ORLEANS MATHEMATICS COLLABORATIVE (NOMC)

by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the New Orleans Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during its second year have evolved in order to reach that goal.

The information presented in this report was culled from the following sources: the interim narrative report submitted by the Metropolitan Area Committee Foundation; documents and interview information provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1987; meetings held during the annual NCTM Conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

NEW ORLEANS MATHEMATICS COLLABORATIVE (NOMC)

A. Purpose

As stated in the proposal submitted to the Ford Foundation, the goal of the New Orleans Mathematics Collaborative (NOMC) is to enhance the professional development of secondary school mathematics teachers in the New Orleans Public Schools and to enrich the teaching of mathematics by providing opportunities for teachers:

1. to become part of a network of mathematicians;
2. to work in collaboration with mathematics teachers and other mathematicians in addressing both teacher and student needs;
3. to keep abreast of developments in the fields of mathematics and teaching; and
4. to experience first hand the ways in which mathematics is used outside the academic setting.

B. Context

Approximately 570,000 people live within the city limits of New Orleans. During the 1950s and 1960s, a steady migration of white middle-class residents to the city's suburbs left behind an inner-city economically impoverished population. In 1980, New Orleans was ranked as the third poorest city in the nation, with 26 percent of its citizens living below the poverty line. The New Orleans metropolitan area has a population of 1,337,400.

The New Orleans Public Schools District (NOPSD) today consists of 127 schools serving approximately 80,000 students; these totals represent decreases of about 9 percent in the number of schools and 3 percent in the number of students since 1986-87. During the 1987-88 school year, approximately 39,000 (49 percent) students were females and 41,000 (51 percent) were males. Eighty-seven percent of the student population was black, 7 percent was white, 3 percent was Asian, 2 percent was American Indian and 2 percent was Hispanic.

Of the total number of students in the NOPSD, approximately 1,000 (1 percent) consider English their second language. One-third of all students in the system are from families who receive AFDC support, and 81 percent participate in government-funded lunch programs.

Approximately 12,000 students were enrolled in the district's twenty-two high schools (grades 9-12) during 1987-88. Fifty-three percent of these were females, 47 percent were males. Ninety percent of the high school population was black, 5 percent was white, 3 percent was Asian, 2 percent was Hispanic, and less than one percent came from other ethnic groups. Nine percent of high school students considered English a second language.

Twenty-one percent of high school students in the system came from families who receive AFDC support, and 75 percent were involved in federally funded lunch programs. Only 50 percent of children entering the public school system are likely to graduate from system high schools. The majority of dropouts leave school in the ninth and tenth grades.

Of the 10,000 ninth and tenth graders who took mathematics courses in the 1987-88 school year, 55 percent were males and 45 percent were females. Information was unavailable for eleventh and twelfth graders. Louisiana students are required to take Algebra I, Algebra II and Geometry in order to graduate.

The mean ACT mathematics test score of the 1987 graduating class was 12.8 percent, compared with 18.7 percent displayed by the national sample, with a possible range of 1 to 36. At the same time, students' scores on the Comprehensive Test of Basic Skills were higher in 1987-88 than they had been since 1983-84.

Approximately 1,200 high school teachers were employed by the district in 1986-87. Of these, 768 (64 percent) were women and 437 (36 percent) were men. Sixty-eight percent of high school teachers were black, 30 percent were white, and 2 percent originated from other ethnic groups. Annual salaries ranged from $16,000 to $26,000. In June, 1988, the state legislature approved an education plan that included a 5 percent increase in teachers' salaries, the first statewide increase in a number of years. The plan also set requirements for establishing a statewide teacher evaluation system, and eliminated lifetime certification and introduced mandatory recertification every 5 years.

During the 1987-88 school year, 286 secondary school (grades 6-12) teachers taught mathematics courses. Of these, 191 (67 percent) were women and 95 (33 percent) were men. Seventy-five percent of mathematics teachers were black, 23 percent were white, and 2 percent were Asian. Less than 1 percent were from some other ethnic groups.

Forty-two percent of mathematics teachers had obtained at least a master's degree and 99 percent had obtained at least a bachelor's degree. Of the total, 259 (91 percent) held regular teaching certification, 8 percent were not certified, and 1 percent had temporary or emergency certification. Eighty-four percent of secondary school mathematics teachers were tenured. The key focus of the collaborative is the approximately 150 senior high school (9-12) mathematics teachers.

The NOPSD's 1987-88 budget totalled approximately $225 million. Fifty-four percent of total revenues came from state funds, 43 percent from local monies, 2 percent from federal reserves and 1 percent from outside sources. The budget allocated $94 million for construction or building improvement in district schools. In April, 1988, New Orleans voters approved 85 percent of a 19.4 recommended property tax millage increase, which represents about $16 million per year in increased school revenues. These funds will be used to help pay for school construction, renovations, teacher pay raises, new programs, and instructional equipment and textbooks. The portion of the millage increase that was not approved was Proposition E, which would have provided for the issuance of bonds to fund new construction. Governor Buddy Roemer later proposed cuts of as much as $29.5 million in state education funds; it is not yet clear what impact this proposal could have on the New Orleans Public Schools if it should pass.

Dr. Everett Williams continues to serve as system superintendent, a position he has filled for the last five years. The position of District Mathematics Supervisor, however, is vacant. Two at-large members will be added in fall, 1988, to the current five-member School Board.

The Portal Early Field Experience Program, which is a cooperative venture between the University of New Orleans and the New Orleans Public Schools, has been implemented to give aspiring teachers hands-on experience with elementary school students before they enter the profession. Mentors who work with aspiring teachers also benefit from learning and evaluating the newest research-based teaching methods.

The Public Schools Scholarship Foundation is in its third year. This program provides scholarships and monetary grants to promising students to enable them to go to college. In March, the district conducted a fund drive in which each student and each employee of the public schools was asked to contribute a dollar.

Martin-Marietta, an aerospace company located in the New Orleans area, was in competition for a large NASA contract to build a space station. The contract would have meant thousands of jobs and billions of dollars for the area, but on December 1, 1987, NASA awarded the contract to Boeing in Huntsville, Alabama. This news was devastating to the community, both as an economic loss and in terms of the extensive effort the city had expended in the competition. Nonetheless, the community did derive some benefits from the experience as all of its diverse constituencies worked toward a common goal and came to realize the importance of a good public education system and of higher education.

C. Development of the Collaborative

The New Orleans Mathematics Collaborative is one project of the Metropolitan Area Committee (MAC) Education Fund. MAC is a nonprofit, citizen's action organization whose membership includes representatives of business, labor, professional, academic, and religious communities in the greater New Orleans area. The committee, founded in 1966 by a biracial group of community leaders, sponsors a wide range of civic and educational activities in New Orleans. In fall, 1987, Constance Barkley was appointed as executive director of the Metropolitan Area Committee. Prior to assuming this position, Ms. Barkley was the director of the MAC Education Fund and the project director for the collaborative. Sally Hayes, the previous executive director of MAC, assumed the position of executive director of the Business Task Force of the New Orleans Chamber of Commerce.

Dr. Olympia Boucree remains the collaborative's coordinator, a position she has filled since the project's inception. Aldonia Winn, a mathematics teacher at Clark Senior High School, is the on-site observer. The position of director of the Education Fund who is also the collaborative director was unfilled until July 1, 1988, when Kimberley Sawyer was appointed by the board. Ms. Sawyer brings experience as a certified public school teacher and experience working with nonprofit organizations to her new position. She served as a founder and director of the South West Gardens Summer Reading Program in Pennsylvania and worked in the New Orleans Public School System as a teacher of gifted students. During the interim, the duties of the director were shared informally by Ms. Barkley and Dr. Boucree.

Steering Committee

The collaborative is governed by a Steering Committee of twenty members, including mathematics teachers, school system administrators, and representatives from the teachers' union, local businesses, universities, and the Louisiana Science Centre. The Steering Committee, which is to meet quarterly, monitors and evaluates programs, and serves as a think tank to solve problems and create new initiatives. In the fall of 1987, R. L. Howard, Chief Executive Officer of Shell Offshore, Inc., agreed to serve as the chairman of the Steering Committee. He replaced Dr. Richard Hayes, who chaired the committee in 1986-87. Mr. Howard had participated in early discussions about the collaborative with Barbara Scott Nelson of the Ford Foundation and members of MAC. He has renewed the collaborative's commitment to strengthening its existing program and is investigating ways of promoting further collaboration among business representatives, university mathematicians, and New Orleans public school mathematics teachers. In February, Mr. Howard requested that each subcommittee develop both long-range and short-range goals. The Steering Committee did not meet as a group during the year.

Four subcommittees of the Steering Committee continue to provide direction and support for specific activity areas: symposia; site visits and internships (including university courses); workshops; and the newsletter.

Symposia Subcommittee

The symposia subcommittee met October 20, 1987 at the University of New Orleans to plan and evaluate the two symposia presented in December and April. The subcommittee suggested that the collaborative staff seek out speakers on current topics in mathematics and requested that the staff try to find noted minority speakers for the symposia.

Site Visit/Internship Subcommittee

The site visit/internship subcommittee met three times during 1987-88: on July 22, October 19, and February 4. Members of this subcommittee contact companies, universities, and other local institutions to request a commitment to host site visits, sponsor an intern, and/or visit a New Orleans public school. The committee had decided to focus its attention on site visits during 1986-87 and to eliminate the internship program for the summer of 1987. For the summer of 1988, however, the subcommittee planned a pilot internship program with just two teachers. In November, subcommittee chairman Ron Masters sent letters to seven local businesses, asking for their participation in both the site visits and the summer internship pilot program. As a result, six businesses agreed to host site visits and the Port of New Orleans hired two teachers to work as statistical analysts for two months during the summer. In February, 1988, the subcommittee established its long-range goals:

1. a long-term internship program;
2. opportunities for teachers to translate real-world experiences into their classroom experiences;
3. a forum for discussion and interaction among high school teachers, university professors, and business persons, to reduce teacher isolation;
4. the opportunity for increased involvement in the educational process, through informal contact with business and universities.

The group's short-term goals included site visits, three internships with companies and universities in 1988, and internships with six companies in 1989.

Workshop Subcommittee

The workshop subcommittee did not meet during the 1987-88 school year. At a meeting held near the end of the 1986-87 school year, however, teachers expressed the view that the "traditional" types of workshops were unpopular and ineffective. In response to this evaluation, the collaborative staff devoted a great deal of effort in 1987-88 to ensure that the three workshops offered by the collaborative would be of the highest quality. On March 11, 1988, Dr. Richard Houde of Weston, Massachusetts, spoke on the Geometric Supposer. Two New Orleans teachers presented a week-long summer workshop on materials and ideas they had gathered at the North Carolina School of Science and Mathematics seminar held the previous summer. In addition, a Woodrow Wilson Institute on geometry was planned for August, 1988.

Newsletter Subcommittee

The newsletter subcommittee, which helps the editor plan and publish the newsletter, is composed of the designated newsletter coordinators from each of the other three subcommittees. At the beginning of the 1987-88 school year, a new editor, mathematics teacher Ella Butter, was appointed. One of Ms. Butter's responsibilities is to solicit news articles from other teachers. Only one issue of the newsletter was published during the 1987-88 school year, in contrast to the three issues that were published during 1986-87. This reduction in publication was attributed to the extensive time and effort required to produce and distribute a newsletter and to the heavy schedule of the new teacher-editor, who also chairs the mathematics department at her school and teaches in the Adult Education program at the vocational school. It is expected that four issues will be distributed annually beginning in 1988-89.

Teacher Advisory Council

A Teacher Advisory Council composed of one teacher from each high school was established in July, 1987. The Council, which meets on an as-needed basis, received $5,000 from the NOMC to fund its 1987-88 projects and activities. All of the travel grants for teachers during the year were funded from this money. A total of $4,928 was spent to send teachers to various conferences (see Activities Section). At its first meeting on July 27, 1987, the ten mathematics teachers present voted to send its co-chairpersons, Brian Decuir and Rosalyn Smith, to the National/Local Action Conference on Science, Mathematics and Technology Education in Alexandria, Virginia on September 9-11. This conference, which was organized by the Triangle Coalition for Science and Technology Education, focused on forming and maintaining coalitions and collaboratives. The Council met for the second time on January 18, 1988, from 4-5:30 p.m. at the Maison Blanche. All mathematics teachers in the NOMC were invited to the meeting but only five attended. The poor attendance was attributed to the fact that the meeting was held on a school holiday. The Council voted to allocate money to send twelve NOMC teachers to the NCTM annual meeting in Chicago. An upcoming workshop, a symposium, and site visits also were discussed.

The collaborative expanded its involvement in the community by participating in a consortium with Southern University, the Urban League of New Orleans, and the American Association for the Advancement of Science (AAAS) Apple Computer project. This group is in the process of establishing a Community Learning Center for the purpose of improving the performance of minorities and women in mathematics and the sciences through the use of computers. The Center will be located at Southern University, which will assume the cost of shipping and handling the computers, and will provide staff, security, and computer maintenance. NOMC will help plan, develop, advertise, and coordinate Center activities. The Center will be open to students and teachers of the New Orleans Public Schools and Southern University 15 hours per day, Monday through Thursday; 14 hours on Friday; 8 hours on Saturday; and 4 hours on Sunday. The Center's goals are to:

1. increase the interest and participation of minorities and women in mathematics and science;
2. reinforce the mathematics, science and computer training of students in the New Orleans public school system; and
3. improve the achievement of public school students (K-12), college students, parents and other adults, and teachers in mathematics, science and computer science.

D. Project Activities

During the 1987-88 school year, the New Orleans Mathematics Collaborative sponsored a variety of activities to provide teachers the opportunity to form networks with their peers, to keep abreast of developments in the fields of mathematics and teaching, to work collaboratively with other teachers and mathematicians, and to experience firsthand the ways in which mathematics is used outside the academic setting. The collaborative also encouraged teachers to participate in a Mini-Grant Program sponsored by the Education Fund of the Metropolitan Area Committee and participated in a collaborative project with other local agencies to establish a Community Learning Center.

Dinner Symposia

Winter Symposium

On December 3, 1987, NOMC sponsored the first of two dinner symposia for the 1987-88 school year. Eighty people attended the symposium, "Mathematics: A Successful Entree to the World of Work," which was held at the Hyatt Regency Hotel. The evening began with a social hour, followed by a short welcome address and introduction of the panel. Panelists included Michael Rapier, former Chairman of Whitney National Bank in Jefferson and currently of Rapier Investments; Glen Davis, President of Cavalier Insurance Agency; and Gail Jones, Chairman of the Delgado College Science and Mathematics Department. Dr. Gino Gautreaux, the assistant principal at McDonogh Senior High School, served as moderator. The three panelists agreed that communication skills, basic skills, and a disciplined mind are necessary prerequisites to a successful entry into the working world.

Audience reaction was strong and immediate when Mr. Rapier expressed the view that bankers are compensated based on "bottom line" results, and teachers should be compensated according to their job performance as well. Tenure does not exist in the business world, Mr. Rapier said, and if teachers want to be viewed as professionals they should not be "protected" by the tenure system. Both teachers and business representatives in the audience expressed strong opinions about Mr. Rapier's statements, and the symposium provided an opportunity for open discussion of a controversial and sensitive issue. Despite their differences of opinion, all of the symposium participants agreed that this free exchange of ideas illustrated the true value of the collaborative--mathematics professionals exchanging perspectives, interacting with one another, establishing a common ground, and getting to know one another. After the question-and-answer session, dinner was served in the ballroom.

Spring Symposium

The Spring Symposium, which focused on the curriculum standards proposed by the National Council of Teachers of Mathematics, was held April 20, 1988, at the Royal Orleans Hotel. R. L. Howard, President of Shell Offshore, Inc. and Chairman of the NOMC Steering Committee, welcomed the teachers and introduced the three speakers. The panelists were: Dr. Christian Hirsch, a mathematics professor at Western Michigan University and the chair of the 9-12 working groups for the NCTM *Standards*, who elaborated on the proposed NCTM *Curriculum Standards* for grades 9-12; Janice Carter, a high school mathematics teacher, who presented an overview of the North Carolina School of Science and Mathematics (NCSSM) math materials; and Ira Nirenberg, a high school mathematics teacher who demonstrated the Data Analyses teaching unit from the NCSSM curriculum materials. Dinner followed the panelists' presentations; a question-and-answer period, general announcements, and closing remarks by Mr. Howard concluded the evening.

More than 100 senior high school teachers, school administrators, and representatives from the university and business communities attended the symposium. Everyone seemed to find the evening very worthwhile. The on-site observer remarked that it was "a successful effort to make all aware of the proposed standards." On the sixty written evaluation forms returned, ratings of the format of the evening, the panel topic, and the panel presentation ranged between 4.0 and 5.0 (very good and excellent) on a 5-point scale. The rating for audience participation was somewhat lower, with the average responses by university professors and business persons at 3.0 and 3.2 respectively, and the average responses for high school administrators and teachers at 4.3 and 4.4.

Site Visits

The New Orleans Mathematics Collaborative arranged six site visits to businesses and industries during the 1987-88 school year. Four of the six sites had hosted site visits the previous year. The New Orleans Public Schools provided release time to allow teachers to participate and acquire practical information to apply to their classroom teaching. Coordinator Olympia Boucree contacted each site to discuss the collaborative's expectations of the visit. Each business then planned the day's agenda and activities, including lunch. The mathematics department chairs at each of the seventeen senior high schools and at the ten junior high schools were asked to designate the teachers who would participate in the site visits. A total of sixty-nine mathematics teachers visited the six businesses to observe how mathematics is used in the workplace. Evaluations showed that although some teachers were initially apprehensive, by the end of the visits the teachers were excited and motivated, eager to bring the information back to their classes.

Consolidated Natural Gas Site Visit

On January 8, 1988, thirteen mathematics teachers representing eleven senior high schools in the New Orleans Public Schools system participated in a one-day visit to the Consolidated Natural Gas Company. The teachers met with senior company officials, who made presentations on computer systems, geophysics, accounting, reservoir engineering, and geology. The presenters emphasized the importance of mathematics in their everyday duties and provided practical applications of algebra and geometry. Lunch was served in the Executive Board Room where Paul Gregg, the comptroller, and Logan Magruder, a representative of the public relations department, welcomed the teachers and thanked them for coming.

The program was very well received. The eleven teachers who completed a written evaluation reported that they found the topics that were covered very useful to them as classroom teachers; ratings ranged from 4.0 to 4.7 on a 5-point scale. The teachers also reported that they had observed applications of the concepts taught in high school mathematics during the site visit; ratings ranged from 4.2 to 4.8 on a 5-point scale. When asked to choose the adjective that best described their feelings about the site visit, five teachers selected "excited," three chose "inquisitive," three selected "involved," and one circled "concerned." One teacher wrote, "This visit was a very enjoyable and rewarding experience. I truly hope that students get an opportunity to visit CNG." Another said, "Excellent workshop--I wish it could be made available to students." A third teacher wrote, "The presentations were very interesting and informative about the use of mathematics in business." A teacher who had participated in the site visit wrote in an article that appeared in the NOMC Newsletter: "We left with several new answers to the often asked question, 'Why do we need this Algebra, Geometry, etc.?' In addition, I think we all left the meeting with a new sense of direction and purpose. Both the Math Collaborative and CNG should be applauded for their unselfish contributions to our young future leaders of New Orleans."

Freeport-McMoRan, Inc. Site Visit

On February 11, 1988, five members of the collaborative visited Freeport-McMoRan, Inc., a world-wide conglomerate of companies ranging from mining to manufacturing, to hear presentations from corporate engineers about how mathematics is used in their jobs.

Four teachers and the NOMC coordinator participated in the visit. They were very pleased with the visit and found it both informative and interesting. According to the written evaluation forms, the four teachers felt both that the information presented at the site visit was useful, and that they had observed applications of concepts taught in high school mathematics. Asked to select an adjective that best described the site visit, three of the four teachers identified "involved," while the fourth teacher selected "inquisitive." One teacher wrote, "Today's site visit was very innovative and highlighted many uses of mathematics in the classroom." Another commented, "The presentations were excellent! I would have liked time set aside for a walking tour of the facility."

New Orleans Public Service and Louisiana Power and Light Site Visit

On March 3, 1988, five teachers from the Orleans Parish Public Schools participated in a day-long visit to New Orleans Public Service, Inc. (NOPSI) and Louisiana Power and Light (LP&L). During the morning, engineers and other staff discussed the uses of mathematics in providing electricity and gas. In the afternoon, the teachers visited the Waterford III facility in Taft, Louisiana. The Waterford III facility, located about 35 minutes from New Orleans, is a nuclear energy power plant. Since the actual generator is not open to the public, a simulator has been installed. The teachers were given a detailed explanation of the workings of the simulator.

The five teachers selected to participate reported that the visit was very worthwhile. Their written evaluation forms indicated that the information presented had applications for the classroom and that they observed applications of high school mathematics concepts during the visit. One teacher wrote, "The visit raised my consciousness level and appreciation for the work and workers at this facility and others like it. It also made me aware of the need to prepare students in the basics so they might be better prepared for such a field. There was also, for me, a sense that we're doing a pretty good job."

D.H. Holmes Site Visit

A site visit to the D.H. Holmes Department Store on March 29, 1988, offered teachers an understanding of how mathematics applications are used in the retailing, distributions, and warehousing of merchandise. Sixteen teachers, one from each high school, heard presentations by Holmes' Vice President of Retailing Harmon Fischer, and other members of the staff. The participants enjoyed the presentations; on the written evaluation forms, they reported that they had observed a great deal of basic math skills, computer usage and graphics. Because the teachers who participated taught algebra through calculus, however, they felt that the visit would not have useful applications to their classroom teaching.

A teacher participant wrote, "Excellent basic applications of addition, subtraction, multiplication and percents. Most informative. Really practical." Another said, "I am looking forward to visiting a distribution center with teachers and students."

The on-site observer commented, "A good site visit with excellent applications of basic operations, especially percents and use of computer. Participants were pleased with presentations but expressed views that a visit to a distribution center would have enhanced the effort."

Shell Offshore Inc. Site Visits

Two site visits to Shell Offshore Inc. were held during the 1987-88 school year. Six teachers, the maximum number eligible, participated in the first visit on April 12; four teachers took advantage of the second site visit on April 26. Topics addressed by the staff of Shell Offshore, Inc. included, "Production," "Well Design," "Reserve Determination," "Well Control," "Exploration," "Seismic Acquisition," "Data Processing," and "Seismic Interpretation for Exploration."

The teachers were generally excited about the visit and felt the information was useful. On the written evaluation forms, the ten teachers reported that much of the information presented at the site visit was useful to them as classroom teachers. They also said that applications of many mathematical topics were observed to a large extent during the site visit. When asked to indicate the adjective that best described their feelings about the site visit, five teachers selected "excited" and two teachers each selected "inquisitive" and "involved." Comments from participants included: "The site visit provided me with more information and examples to use in our mathematics department"; "Excellent, I thoroughly enjoyed the workshop and hope to be a part of it again"; and "Enjoyed the day very much. Most informative." After the April 26 site visit, one teacher said, "I found this session very interesting. I got a lot of information regarding the amount of mathematics and computer usage needed to operate effectively." Another added, "The session was very interesting and informative to me as a classroom teacher. It was good to realize that the concepts in geometry and algebra are used so much in the oil industry."

Southern Regional Research Center Site Visit

On April 14, 1988, thirteen high school mathematics teachers visited the United States Department of Agriculture Southern Regional Research Center (SRRC). SRRC is a U.S. government research lab that studies farm products grown in the area. The lab also researches the process by which fabrics are made from cotton. The site visit provided teachers with an opportunity to learn about mathematics applications in food and textile research. They observed raw products as they passed through each stage of the refining process, the mathematics used in each step, the computer data being used, the graphics, the mathematics being used, and in many cases the final product.

Participants rated this site visit the highest of any of the site visits. Teachers indicated that the information presented would be useful in the classroom (4.6 on a 5-point scale) and that they observed applications of concepts taught in high school mathematics (4.9 on a 5-point scale). Asked to select an adjective that best described their feelings about the site visit, six teachers selected "excited" and three chose "inquisitive." The on-site observer reported that it was "an excellent site visit for mathematics teachers." One teacher wrote, "Excellent example of mathematics employed in business." Another said, "More, more, more involvement with schools. Send representatives out to the schools." A third teacher said, "The tour was well designed and executed. I would like to participate in many other such programs." A fourth teacher stated, "This visit was wonderful."

Workshops

Geometric Supposer

On March 11, 1988, Dr. Richard Houde, a teacher from Weston, Massachusetts and a consultant for the Education Technology Center, conducted a workshop on the Geometric Supposer from 8:30 a.m. to 3:15 p.m. The Geometric Supposer, a software package which helps students develop geometrical thought patterns, is being used nationwide to enhance geometry instruction. Eighteen teachers, representing each of the sixteen New Orleans public high schools, participated. The excellent attendance was attributed to the cooperative efforts of the NOPS central administration, the principals of the senior high schools, and the collaborative.

During the workshop, the teachers were able to use the software as well as to review problems that had been solved by Dr. Houde's students. Teachers also received several sheets of problems that could be used with the Supposer and in their classes.

The workshop was very successful. In an article in the NOMC newsletter, one teacher wrote: "The workshop was well conducted and very motivating. Each teacher gained important information and left the workshop with a better understanding of how the computer can be used as an educational tool in the Geometry classroom." Comments on the written evaluation forms included: "Excellent throughout"; "The ideas and activities were very different and can be used in my class"; "We should have more workshops like this one"; and "More, more, more." The on-site observer reported, "Participants were engrossed in activity and enthusiastic about the program. An excellent workshop."

The on-site observer also reported that many of the teachers would like to start using the Geometric Supposer in their classes in the fall, but they were concerned about the cost of both the hardware and software.

Special Topics in Mathematics Using NCSSM Curriculum Materials

On June 13-17, 1988, the collaborative sponsored a five-day workshop at McDonough #35 Senior High School to present the "Introduction to Pre-Calculus Materials" produced by the North Carolina School of Science and Mathematics (NCSSM). The workshop was conducted by the two high school teachers from the New Orleans Public Schools who had received collaborative funding to attend a training session at NCSSM during the summer of 1987. There was no registration fee and participants received materials, software programs, and lunches. The workshop was opened to all senior high school mathematics teachers. Teachers were asked to submit an application expressing their interest to attend. Because the number of applicants did not exceed the limit, all of the eleven junior and senior high school teachers who applied were accepted. The collaborative, which received $2,500 from NCSSM to help cover the costs of the workshops, paid each of the two workshop leaders $500.

The workshop covered various mathematical topics that use the computer as an aid to problem solving, including geometric probability, data analysis, matrices and functions. Participants explored and discussed methods of incorporating these topics into the secondary mathematics curriculum. Computers for the workshop were provided by the New Orleans Public School administration and graphing calculators were supplied by NOMC.

The workshop was very successful. On the written evaluation forms, nine of the eleven teachers rated the overall workshop as a 5 on a 5-point scale. The tenth teacher rated the workshop as a 4, while the eleventh teacher superceded the scale and gave the workshop a rating of 6. The teachers' comments supported these high ratings, and many of them requested a follow-up workshop.

One teacher wrote, "Presentation and demonstration were excellent, easily understood and would be easily implemented if I had access to a computer." Another commented, "It was relevant, the lecturers knew their material. Could we have this kind of workshop on a more regular basis? I like it when teachers teach teachers." A third said, "This was the best workshop I've ever attended."

Industry Internship Program

During the 1987-88 school year, the collaborative, in conjunction with Loyola University, initiated the Industry Internship Program. The program is designed to give teachers the opportunity to work in a business atmosphere with the anticipation that they will return to the classroom with more creative skills and teaching techniques. Two senior high school mathematics teachers worked from June 13-August 5 as assistant statistical analysts in the marketing and sales department of the Port of New Orleans. The Port of New Orleans paid each intern $7 per hour for eight 40-hour weeks. The internships were publicized in collaborative literature and seven teachers applied. A selection committee, including the chairman of the site visit/internship committee, a university professor, and the collaborative coordinator, identified three names from those who had applied. These names were given to the Port of New Orleans people, who then made the final selection of the two teachers to fill the internship positions.

The program was viewed as a success by both the hosting industry and the teacher interns. An interim evaluation indicated that not only did the teachers enjoy the experience, but the officials at the Port did as well. One of the two teachers remarked, "It was important to me to accomplish something significant and show them [the Port supervisors] that teachers are capable of performing." Brian Kolowick, who supervised the teachers, said, "I was amazed at how quickly they learned. Anyone who agrees to do this type of project needs to spend time with the teachers to get them oriented, but it's well worth the time spent. I have thoroughly enjoyed this project."

At the end of the summer, both teachers agreed that the summer-long internship was a productive learning experience. One of the teachers said, "Not only did I learn some things such as creative writing and thinking skills, but I also learned about the Port of New Orleans being the second largest port in the nation. I learned about the vast commodities coming into the port from all over the world. I can also bring back to the students at Kennedy High School the possible job careers which are available to them. The students need to know about the possibilities that lie ahead for them."

On August 17, 1988, R. L. Howard, chairman of the NOMC Steering Committee and Chief Executive Officer of Shell Offshore, Inc. will host a breakfast meeting for business executives and personnel directors to discuss their participation in the Industry Internship Program. During 1988-89, NOMC will continue to work with Loyola University to develop the academic component of the program. Tuition-free classes will be offered to teacher-interns, and course materials for classroom use will be developed.

Mini-Grant Program

The collaborative encouraged and supported teachers to make use of the Mini-Grant Program of the Metropolitan Area Committee Education Fund. During the 1986-87 school year, the NOMC awarded $4,478.66 in MAC Education Fund mini-grants to ten Orleans Parish public school teachers for mathematics-related projects. The MAC Education Fund had reserved $10,000 to award during 1986-87 for mathematics projects.

The MAC Education Fund then made the decision that it was impractical to have two submittal dates for applications, one in the spring and one in the fall, and that mini-grants should be given only one time during the year. It was decided to begin this new procedure in the fall of 1988. Thus, during the 1987-88 school year no mini-grants were funded.

National and Regional Conferences

North Carolina School of Science and Mathematics Summer Workshop

In July, 1987, two senior high school mathematics teachers from the New Orleans Public Schools participated in a twelve-day workshop at the North Carolina School of Science and Mathematics (NCSSM). The workshop focused on the new fourth-year mathematics curriculum the NCSSM mathematics department is developing. The curriculum is viewed as representative of future trends in mathematics education. The course stressed an applications approach to the study of pre-calculus and covered six modes of mathematics thought: geometry, data analysis, probability and statistics, mathematical modeling, computers, and finance.

The workshop included a strong teacher training component, funded by NSF, to enable teachers to assume a leadership role in instructing others in the use of the NCSSM syllabus. Each team of teachers that participated in the workshop was expected to assist in the pilot testing of some of the newly developed instructional units during the 1987-88 school year and to conduct a one-week workshop for their colleagues during the summer of 1988. (The workshop, conducted by the two NOMC teachers on June 13-17, is described earlier in the report.)

Southeastern Regional Conference

The collaborative sponsored one teacher's attendance at the Southeastern Regional Conference, held in Atlanta, Georgia, March 3-5, 1988. The teacher reported that the meeting was most informative.

Southwestern Regional Conference

One teacher from the New Orleans Mathematics Collaborative received funding to attend the Southwestern Regional Conference, held in Marshall, Texas, March 10-12, 1988. The teacher said that she enjoyed the conference and found the meetings extremely beneficial.

Annual Meeting of the National Council of Teachers of Mathematics (NCTM)

During 1986-87, the NOMC Teacher Advisory Council awarded travel grants to fund twelve senior high school mathematics teachers to attend the Annual Meeting of NCTM in Chicago, Illinois, April 6-9. The collaborative paid the costs of registration and travel for each teacher; substitutes' fees were covered by the district.

During the four-day conference, the collaborative sponsored a meeting of New Orleans teachers to provide them an opportunity to discuss the NCTM *Standards* and the status of mathematics education in New Orleans. Strategies for enhancing classroom effectiveness included spending more time on developmental instruction and less on rote practice, discouraging rigid class grouping and teaching, increasing communication across curriculum areas, using calculators, emphasizing estimation as a life skill, giving students the opportunity to communicate mathematically, integrating probability into the curriculum, and providing more hands-on experiences in high school mathematics classes.

The teachers endorsed the NCTM *Standards* and suggested that the New Orleans Public Schools system pilot segments of them in several schools. The collaborative encouraged teachers to actively participate in professional organizations. The on-site observer reported that the meeting was very valuable and of great benefit to participants, who suggested that such open discussion and exchange of ideas should occur more often.

Mathematics Reform and Teacher Professionalism Conference

Two NOMC teachers attended the Mathematics Reform and Teacher Professionalism Conference at the North Carolina School of Science and Mathematics in Durham, North Carolina, on June 23-24. The conference was designed to inform and guide the broader mathematics community in its effort to improve mathematics education at the pre-college level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. The conference focused on helping educators understand the need for change in mathematics education and developing strategies for bringing about that change. One of the two teachers who attended the conference reported that the conference was informative and helpful.

Collaborative Newsletter

The collaborative publishes the "NOMC Newsletter" three times each year and distributes it to all secondary mathematics teachers in the New Orleans Public Schools, as well as to collaborative board members, MAC board members, business partners, and the school district administration. The newsletter announces upcoming events, reports on collaborative activities, offers commentary from teachers, provides articles on topics in mathematics, and serves as a vehicle for teachers and business representatives to express their views on the collaboratives in general.

The change in editor which occurred at the beginning of the school year, as well as the organizational and planning time required to produce the newsletter, resulted in only one issue being published during the 1987-88 school year. The collaborative intends to publish three issues of the newsletter in 1988-89.

E. Observations

Project Management

In 1987-88, the New Orleans Mathematics Collaborative experienced changes in some of its leadership roles while continuing the pattern of activities it had established during its first year of operation. Dr. Boucree's continued presence as project coordinator provided the collaborative with strong leadership and continuity; the assistance she continued to receive from Ms. Barkley after she became executive director of the Metropolitan Area Committee is another factor in the project's ongoing stability and success. Finally, the collaborative's new committee structure fosters efficiency and provides clear-cut processes by which project activities are planned and presented.

The smooth transition in the Steering Committee's leadership from Richard Hays to R. L. Howard suggests that the New Orleans business community is deeply committed to the collaborative's success. Mr. Howard assumed direction of a well-organized committee, and he has provided it with continued leadership and direction. However, with the change in leadership, there was a change in management approaches. As his first action, Mr. Howard requested that each subcommittee prepare a statement of goals.

An important development during 1987-88 was the collaborative's effort to enhance teacher leadership by establishing the Teacher Advisory Council. One teacher representative from each school was appointed to the Council, funding was made available, and the teachers were left to decide what should be done. At its first meeting in August, the Council voted to fund teachers' attendance at a variety of professional meetings. After some discussion, the teachers decided to meet again in January. Although the Council's role and agenda remained somewhat undefined at the close of the 1987-88 school year, it is significant that a group of teachers, empowered to make decisions that affect the professional lives of their colleagues, is learning to assume new roles and new responsibilities.

Collaboration

Collaboration is taking place in New Orleans at many different levels: among mathematics teachers within schools, among mathematics teachers from different schools, and between mathematics teachers and other mathematics users from business and higher education. The collaborative's governing structure and the activities it has planned have helped to strengthen such cooperative effort; representatives of all three sectors serve on the subcommittees and actively interact as they plan for the collaborative's future.

Project activities are structured to enhance collegiality, introduce new concepts and approaches to the teaching of mathematics, and foster collaboration between teachers and members of the business and university communities. Symposia are designed to provide teachers an opportunity to interact with their colleagues and to exchange views and ideas with mathematicians from business, higher education, and the schools. Such interaction breeds mutual respect and understanding. Workshops provide teachers the opportunity to learn new ideas about mathematics and teaching. Site visits and internships allow teachers to interact with business people while learning about mathematics applications in the world of work. As one teacher noted: "The collaborative has helped me to form relationships with more math teachers and mathematicians . . . by providing the opportunity to meet, work and 'play' with them at dinner meetings, workshops, site visits, other meetings, etc."

The collaborative's activities and progress are beginning to have an effect on New Orleans teachers. In one respect, teachers are more interested in their work because they have become better acquainted with their colleagues and no longer feel isolated or alone. One teacher who is a frequent participant in collaborative activities said: "The math collaborative has helped to unify and promote harmony and sharing at my school. The meetings have afforded us the opportunity to share and come together outside of the school setting, which permitted us to work with one another better." A department head reported, "In my school--I see closer relationships in the math department".

In addition, the collaborative has promoted a sense of collegiality among teachers from different schools, and between teachers and representatives of business and higher education. As one teacher noted, "I have made many new friends--with mathematics teachers, university professors and business persons." A department head who is a frequent participant in collaborative events said, "The collaborative has been the vehicle for a vital increase in sharing with mathematics co-workers, in other schools, mathematicians in other areas of business/industry, and higher education." In answer to questions about the collaborative's impact, New Orleans collaborative participants more often mention the importance and value of the relationships they are forging with mathematicians in other sectors than do participants in other collaboratives--a difference that may suggest that NOMC's approach to collaboration is working.

A core of seventy-five teachers--about 50 percent of the project's membership--has emerged who consistently participate in collaborative activities. This group has evolved out of those who attend the symposia, which include 70 to 80 percent of the high school mathematics teachers, and those who go on site visits, which nearly always involved at least one teacher from each high school. Another factor contributing to the formation of the core of teachers is the Teacher Advisory Council, although it remains in its formative stages and at this point has not developed into a real source of collaborative cohesion and leadership.

The number of businesses that hosted site visits increased from four in 1986-87 to six in 1987-88. This expansion, and the continued involvement of business people on the subcommittees and as speakers for the symposia, suggest that the interest of businesses remains high. It appears that local businesses are convinced that improving the public schools is one important part of economic development in New Orleans.

Professionalism

The collaborative has increased many teachers' participation in professional activities. By sponsoring teachers to attend the NCTM Annual Meeting and providing workshops and symposia, the collaborative has helped to keep teachers informed of the latest trends in mathematics education. As a result, some teachers are changing their ideas about what they should be doing. When asked about the results of the collaborative on the mathematics curriculum, one teacher commented, "The curriculum hasn't changed, but what teachers do with it has. We have become innovative." Another teacher supported this view: "We have become, on the whole, more innovative. We have tried new techniques, ideas and approaches in the classroom." A department chair noted as the most significant changes attributed to the collaborative, "I find that teachers involved in the collaborative have a new optimism--they are coming back to school with new ways of teaching some difficult topics."

One arena in which the collaborative has had little effect is teachers' involvement in decisions on school-related issues, such as in the areas of textbooks and assessment instruments. One reason for this lack of involvement is the tight control exerted by the state in these areas. Another area that will receive more collaborative attention in the coming year is the project's mini-grant program. During its first year, the collaborative allocated funds to offer teachers who applied to the MAC Education Fund for mini-grants. At that time, ten teachers received mini-grants, which used about half of the available funds. One teacher found a mini-grant to be very helpful: "The most important change [in working conditions] is in the amount and types of new materials available because of the mini-grant fund." However, because of adjustments in the program, no mini-grants were granted in 1987-88. In May, 1988, a letter from the MAC executive director was sent to all mathematics teachers encouraging them to begin thinking about and writing proposals over the summer for the next round of mini-grants in October.

It appears that the collaborative's efforts have wielded the greatest impact on the professional lives of New Orleans teachers in terms of the increased opportunities they now have to attend professional meetings, the new invigoration they feel for teaching, and the new ideas they now develop and share about teaching. As one teacher said, "Teachers are updating their skills, attitudes and self-esteem."

Mathematics Focus

The collaborative's mathematics focus centers on updating teachers about innovative approaches to the curriculum, informing teachers on the use of technology in teaching mathematics, and acquainting teachers with real-world applications of mathematics. It is interesting to note that, after two years of collaborative effort, some of the teachers from New Orleans have begun to present the new ideas, such as the teacher-directed workshop on the NCSSM materials. Also during the year, teachers had the opportunity to hear a presentation on the new NCTM *Curriculum and Evaluation Standards*, attend a workshop on the Geometric Supposer, and talk about applications of mathematics on site visits. It appears that some of these new ideas are finding their way into the classroom. One department chair responded to the question about the effect the collaborative has had on daily teaching, "I find that I focus more on selected topics--real world, practical topics as opposed to as many topics as I can teach out of the book!" Another teacher said, "The NOMC has helped me realize that showing the students the various ways that math is used on the job can help to increase student's interest in math."

Because of their collaborative participation, teachers report that they have become more aware of current trends in mathematics education. The symposia and workshops have been instrumental in the development of this new awareness. As a result, teachers report being more innovative in the classroom and more willing to try new ideas. A district requirement that all students must take Algebra I, Geometry, and Algebra II created a variety of curricular concerns among teachers. In response, the collaborative offered a workshop and a Summer Institute (1988) on geometry. Teachers remain concerned about how they will get all their students through the requirements, but, at minimum, the collaborative has provided hope. As one teacher said, "I feel that the most significant changes that can be attributed, at least in part, to the collaborative are:

1. The increase in 'hope' that mathematics can be taught so that students experience greater success.
2. An increase in positive feeling by mathematics teachers about the 'value' of their efforts.
3. An improvement in communication and cooperation in schools, among schools, and in the community."

F. Next Steps

The staff of the New Orleans Mathematics Collaborative envisions a more active and involved Teacher Advisory Council. It is striving to convince teachers to dedicate more "out of school" time to collaborative activities. This year, the collaborative administration will ask the teachers who have exhibited leadership up to this point to encourage their peers to get involved.

The staff of the Math Collaborative will continue to work closely with the Division of Educational Programs of the New Orleans Public Schools to serve as a source of professional development for teachers in the area of mathematics. Elementary and middle/junior high school teachers will be invited to participate in those activities that are relevant to their grade levels. Among the activities already planned are a one-week Woodrow Wilson Institute on Geometry to be held in August, 1988, and a symposium series for the upcoming school year. The collaborative also will continue to encourage teachers' attendance at professional meetings by providing financial assistance to support their participation.

The staff of the Mathematics Collaborative also will continue to work closely with the business community and will make a special effort to encourage business representatives to be more visible at the symposia. The collaborative's efforts in 1988-89 will be directed toward offering workshops that expand upon topics introduced at the symposia, developing contacts made at site visits into teacher internships, and establishing the newsletter as a vehicle for the dissemination of information about all collaborative activities and events.

SUMMARY REPORT
PHILADELPHIA MATH SCIENCE COLLABORATIVE
by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Philadelphia Math Science Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Philadelphia Math Science Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1987; meetings held during the annual NCTM Conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

PHILADELPHIA MATH SCIENCE COLLABORATIVE

A. Purpose

A primary purpose of the Philadelphia Math Science Collaborative is to promote teacher leadership and team building, and to contribute to a cohesive vision of mathematics teaching for the future. These activities are viewed as an initial step toward the goals of promoting change and empowering teachers to make needed changes.

The specific goals of the Philadelphia Math Science Collaborative are:

1. to develop, document, and evaluate the position of an in-school collaborator who would be responsible for fostering communication among teachers, including across disciplines, and for serving as a catalyst for innovation and change;
2. to increase teacher participation in extramural professional development programs that offer:
    a. partnerships between teachers and their colleagues in academia and industry;
    b. opportunities to enhance and improve teachers' knowledge, skills and professionalism; and
    c. new ideas and opportunities for mathematics instruction, including integration of mathematics and the sciences, and use of calculators and computers to teach mathematics and science.
3. to develop a model for documenting and evaluating the impact of both the in-school mathematics collaborator's activities and teacher participation in extramural programs on the quality of teachers' professional lives, with close attention to the role of teachers as leaders and problem solvers.

B. Context

The Philadelphia Math Science Collaborative operates in a large urban school district that is divided into seven administrative subdistricts. In sharp contrast to many of the other school districts in the UMC Project, the population of Philadelphia's schools has decreased by about 16 percent since 1980. Of the total 200,00 students, 64 percent are black, 24 percent are white, 9 percent are Hispanic and 3 percent are Asian. Forty-seven percent of students are from low-income families.

The student-teacher ratio in the Philadelphia school district is approximately 10:1. Fifty-nine percent of teachers are white, 39 percent are black and 1 percent are Hispanic.

Approximately 50,000 students attend Philadelphia high schools. Of these, 63 percent are black, 25 percent are white, 8 percent are Hispanic and 4 percent are Asian. Thirty-six percent of all high school students come from low-income families, and 12 percent drop out each year.

Twenty-one of the district's thirty-three high schools are considered "comprehensive high schools" and educate 70 percent of the city's teenagers. These schools are characterized by high dropout rates, low student achievement and teacher burnout. In response to overcrowding in the 1960s and more recently to gang violence, ten Philadelphia high schools have shortened their school day by an hour and eliminated the student lunch period as a way of decreasing the amount of unscheduled time students have while on school grounds. Fifty-nine percent of the Hispanic students, 51 percent of the black students and 16 percent of the white students attend one of these ten high schools.

Of the 1,900 high school teachers in the district, 57 percent are white, 42 percent are black and 1 percent Hispanic. The student-teacher ratio is about 26:1.

During the 1987-88 school year, the Philadelphia Math Science Collaborative (PMSC) focused its efforts on nine target high schools, representing five of the seven administrative subdistricts in the city. Approximately 17,000 students, representing 11 percent of the total population in the five subdistricts, attend one of the nine target schools. Seventy-six percent of these students are black, 11 percent are white, 10 percent are Hispanic, 3 percent are Asian and less than 1 percent are of other ethnic origins. Forty-one percent come from low-income families. Sixty-five percent of the students in the target schools are enrolled in mathematics, with 48 percent of the total number of students receiving credit for mathematics for the 1987-88 school year. In 1987, SAT scores for the 942 students from collaborative schools averaged 342 in Verbal aptitude and 385 in Mathematics aptitude, compared with state averages of 428 and 463, and national averages of 430 and 476, respectively. Twenty-two percent of the students in the nine target schools were retained in grade for the 1987-88 school year. The dropout rate across all PMSC schools in 1987-88 was approximately 14 percent.

Of the 800 teachers in the nine target schools, 68 percent are white, 31 percent are black, and 1 percent are of other ethnic groups. Thirty percent of the 146 mathematics teachers employed by the target schools are members of a minority group.

In May, 1988, negotiations between the Philadelphia Federation of Teachers and the school board were completed on a new four-year teachers' contract that went into effect in September, 1988. It is important to note that the negotiations were completed a significant amount of time prior to the contract deadline. The agreement included both a longer school week and year, and salary increases that will make Philadelphia teachers among the best paid big-city teachers in the nation. Teachers are to receive $900 plus a 4 percent increase the first year, a 4 percent increase the second year, a 5 percent increase the third year, and a 6 percent increase the fourth year. To help fund the contract, both the teachers' union and the School Board went to the City Council in support of a tax increase; the Council voted it down. While the School Board will have no trouble financing the new contract in 1988-89, the Council's decision not to raise taxes has the potential of creating serious financial problems in the coming years.

The School Board voted to extend Superintendent of Schools Dr. Constance Clayton's contract through 1990 and raised her salary to approximately $100,000 per year. Dr. Clayton plans to reorganize the city's twenty comprehensive high schools. Many educators feel that these schools are mere holding pens for the least-motivated and least-successful inner-city students. Merit pay may be used as incentive to curb teacher burnout. A minimum salary of $17,500, beginning in July 1, 1988, was set during the year.

C. Development of the Collaborative

During the 1986-87 school year, the Philadelphia Math Science Collaborative was governed by an Advisory Council. This twenty-four-member group, however, found it difficult to provide the collaborative coordinator the support she needed. The size and composition of the group and the lack of a clearly defined role prohibited the Council from doing much other than hearing progress reports and engaging in general discussion. During the year, the coordinator tried in a variety of ways to involve the Council in generating programming ideas and making decisions for the collaborative, but her efforts were unsuccessful. At the beginning of the 1987-88 school year, the collaborative administration replaced the Advisory Council with a Steering Committee and two working committees, Communications and Program Planning. The Steering Committee was given the overall responsibility for making decisions for the collaborative. The committee, which meets for 90 minutes at the Franklin Institute every other month, has fourteen members: two teacher representatives from target high schools, the district director of mathematics, the district director of computer science technology, the district director of science, the director of PRISM, the director of PRIME, two representatives from business, two representatives from higher education (Drexel and Temple), Sue Stetzer, Wayne Ransom, and Joyce Neff. On average, ten committee members attended each meeting during the 1987-88 school year. The Steering Committee is responsible for networking among the different groups, and for identifying trips, speakers, and educational opportunities for teachers. The primary task of the committee during the school year was to define the future of the collaborative. The meetings were used to keep members informed of the collaborative activities, to discuss PRISM and its fit with the collaborative, and to provide input for the permanence proposal.

Communications Committee

The Communications Committee was formed to address issues of communication among mathematics and science teachers, and among their constituent groups. The committee also coordinates the information included in newsletters and other publications distributed to the teachers by area organizations. The committee's fourteen members include three teachers from collaborative high schools, two from the district administration office, four from higher education, one from the teachers' union, one from PATHS/PRISM, Dr. Elizabeth Haslam (documenter), the on-site observer, and the collaborative coordinator. On average, eight people attended each of the four meetings held during the school year. Meeting discussions focused on such topics as improvement of communications at various organizational levels, the possibility of bringing together editors of publications that serve the collaborative's constituency, communication difficulties within departments, computer software guides, mailing the collaborative newsletter directly to teachers, and the permanence of the collaborative. At the April meeting, members expressed the opinion that the committee was worthwhile and should continue to meet, but that the meetings should be limited to twice a year. The meetings proved to be more valuable in providing committee members with a network of people involved in writing newsletters than in meeting specific communication needs of the collaborative.

Program Planning Committee

The Program Planning Committee has eighteen people on its mailing list, including eight teachers from seven of the nine target schools, three from the school district offices (science, mathematics and computer science and technology), two from businesses (Philadelphia Gas Works and IBM), two from universities (Drexel and University of Pennsylvania), one from Philadelphia Community College, one from the Philadelphia College of Textiles and Science, and one from SIAM. The collaborative coordinator and on-site observer also attend committee meetings. On average, ten committee members attended each of the four meetings held during the year. In general, the committee is responsible for generating ideas for programs that the collaborative could offer to meet the needs of teachers. This year, the committee discussed services the collaborative could offer to departments, means of informing teachers of collaborative activities, Professional Enrichment Grants, teachers' sense of the collaborative, professionalism and collaborative activities, and models for linking mathematics and science teachers.

PATHS/PRISM

The collaborative is funded through the Franklin Institute Science Museum and is an adjunct to the Philadelphia Renaissance in Science and Mathematics (PRISM). During 1987-88, PRISM and PATHS were combined under one organization called PATHS/PRISM: The Philadelphia Partnership for Education. Judith Hodgson was appointed to be the executive director of this organization, and Fred Stein was appointed to be the new director of PRISM. Wayne Ransom, Vice President for Programs at The Franklin Institute and Director of the Collaborative, continues to sit on the PATHS/PRISM advisory board, along with Fred Stein. Following the merger of PATHS and PRISM, it was suggested by the executive director and PATH/PRISM Board that the collaborative be administered by the PRISM component of the merged organizations as the means to permanence. As a result of reorganization and the consequent change in leadership, PRISM experienced a decline in funding over the year and the PRISM documenter, who had helped the collaborative to document its own growth, was dismissed. The collaborative assumed the cost of this position so that the documenter could continue her work through the school year.

During the 1987-88 school year, the number of target schools was increased from six to nine, with four more to be added at the beginning of the 1988-89 school year. In June, 1988, seven schools applied to become one of the four new target schools; Gratz, Kensington, Bok, and Germantown were selected. Advantages of being a target school include: (1) the collaborative pays for teachers' membership in their local organization, (ATMOPAV for mathematics teachers and PSST for the science teachers); (2) target schools are eligible for Professional Enrichment Grants; and (3) target schools may use the services of the in-school collaborator.

One of the collaborative's major efforts this year involved development of the permanence proposal. Because of the nature of PRISM and the collaborative's relationship to it, it was generally agreed that the collaborative should be permanently placed within the PRISM structure. Given this, the collaborative's energies this year were devoted to determining the best way for the merger to take place, how the collaborative would be governed within PRISM, and what support would be provided by the School District of Philadelphia. In December, the Steering Committee began its discussion of the implications of collaborative permanence. This discussion was continued at the committee's February and April meetings. At their February and April meetings, the Communication and Program Planning committees contributed suggestions to the collaborative coordinator that were incorporated into the draft of the proposal. Other teachers were invited to offer input through articles in the collaborative's newsletter, at luncheons, and at other collaborative meetings. The collaborative director met with the directors of PRISM/PATHS and administrators from the school district to negotiate funding arrangements. The proposal, which was prepared by the collaborative coordinator and the director, was reviewed by the three governing committees at a joint end-of-year reception in June, 1988.

The collaborative coordinator spends a majority of her time visiting schools and working with individual teachers and departments to help them address their unique interests and needs. During 1987-88, she helped departments bring in outside speakers, assisted teachers in applying for professional enrichment grants, supported the interaction between mathematics and science faculty, and encouraged teachers to attend special conferences. Teachers have called Ms. Stetzer when they need information or help with a specific problem. Teachers know that they need to make only one phone call to find someone who will help locate what they need. The coordinator also spends time creating and monitoring networks among teachers (Geometric Supposer and ACCESS) and planning after-school programs. The NCTM *Curriculum and Evaluation Standards* were emphasized in a number of collaborative activities during the year. A small percent of the coordinator's time is devoted to administrative tasks.

D. Project Activities

One goal of the Philadelphia Math Science Collaborative is to increase teacher participation in the many professional development programs offered in the Philadelphia area. During the 1987-88 school year, the collaborative publicized and encouraged secondary mathematics and science teachers to attend such events as the Summer Institute in Secondary School Mathematics at Beaver College; the Mathematics Colloquia Series co-sponsored by Beaver College and the School District of Philadelphia; the PRISM Institute on Discrete Mathematics at Beaver College; the Second Annual Teacher Overnight Science Program at the Franklin Institute Museum; the PRISM Academic Coaching Committee and school grant program; the Woodrow Wilson Statistics Institute at Philadelphia College of Textiles and Science; the ATMOPAV fall conference and spring banquet; meetings of the Philadelphia Secondary Science Teachers Association (PSST) and of the Pennsylvania Council of Teachers of Mathematics (PCTM); the Philadelphia Federation of Teachers Health and Welfare Fund educational conference; the Math Seminar Series at the Franklin Institute; Teacher Energy Tours and a conference sponsored by the Philadelphia Electric Company; computer workshops sponsored by the Regional Computer Resource Center at the Philadelphia College of Textiles and Science; the PRISM Grant Fair; a Science and Math Teachers Workshop at Drexel University sponsored by the Engineers Club of Philadelphia; the Physical Science Institute at Temple University sponsored by the Division of Science Education; and a lecture series at Drexel University in honor of Mathematics Awareness Week in May.

During the 1987-88 school year, the Philadelphia Math Science Collaborative also sponsored a variety of activities and programs for mathematics and science teachers in nine target schools. The programs were designed to foster teacher professionalism, to integrate mathematics and science in the high schools, and to promote the use of technology in high school mathematics and science classes. In some instances these programs also were opened to mathematics and science teachers from other Philadelphia high schools. These special collaborative-sponsored programs are described later in this section of the report.

In addition to the activities sponsored and promoted by the collaborative, mathematics and science departments in the target schools held many joint meetings and planned some of their own school-based activities. These in-school activities varied in nature. While some mathematics and science departments met to explore a topic of common interest to both disciplines, such as telecommunications, a few target schools directly addressed the issue of interfacing mathematics and science. Over the last two years, these departments have invited almost thirty outside speakers to make presentations on a variety of content and educational topics. West Philadelphia High School, for example, offered a series of eight sessions on the methods, pedagogy and evaluation of problem solving; another target school offered a session on Islamic Art, followed by a workshop for students on the creation of tessellations. In one school, the science teachers agreed to provide their colleagues in the mathematics department with copies of the science worksheets they used that contained mathematics problems. It is anticipated that the sheets will be used to develop a resource file of science applications that can be used in teaching mathematics.

The mathematics teachers have agreed to reciprocate next year with worksheets on measurement, linear equations and graphing--topics of interest to the science teachers. Department heads commented that the collaborative inspired them to make the effort necessary to plan a department meeting offering more than a bureaucratic shuffling of papers.

As an in-school collaborator, Project Coordinator Sue Stetzer spent a great deal of her time helping teachers plan such activities, identifying resources that could be developed and used, and encouraging teachers within each school to interact with one another. She met regularly with departments to become acquainted with the teachers and to keep them informed of the opportunities and resources available to them. This was particularly important at the beginning of the school year, when teachers in the new target schools were learning about the collaborative. During the school year, Ms. Stetzer also spoke at department meetings on such topics as the use of modems and demonstrations of science software.

Math Science Dinner

On December 17, 1987, the collaborative and Temple University co-sponsored a dinner meeting of science and mathematics educators at the university's faculty club to plan ways to bring mathematics and science teachers together. Discussions focused on ways to foster collegiality between teachers of mathematics and science, as well as an examination of the commonalities between the two disciplines. Fifteen people attended, including the Assistant Director of Mathematics and the Director of Science from the Philadelphia School District, two Temple science professors, one Drexel mathematics professor, nine mathematics and science teachers, and the collaborative coordinator. The collaborative helped to recruit the teachers and publicized the event.

The meeting was a success and participants agreed that a strong dialogue was established. Three concrete proposals were developed: pairing math and science teachers in each target school; developing a "time line" relating math and science content over the course of the school year; and producing a video-tape of a math and science teacher presenting the same content (i.e., logarithms) to evaluate the possibility of revising the curriculum sequence to better integrate mathematics and science instruction.

As an outgrowth of the dinner meeting, a Mathematics, Science, and Technology Conference is planned for September, 1988. One teacher commented, "It was wonderful to meet college people and have college and high school teachers exchanging ideas."

Another said, "It was an enjoyable evening. I hope it is a beginning of more interchange of ideas." The on-site observer reported, "It was a wonderful evening. Lots of talking went on. We talked about math and science courses intertwining and that courses should show dependence upon each other and thereby become more meaningful. I think there was definitely a positive reaction by all who attended."

After-School Programs

At the suggestion of the Program Planning Committee, the collaborative offered four after-school programs for mathematics department heads and teachers during the 1987-88 school year. Participants reported that these events were valuable in that they helped to expand teachers' visions of mathematics and science beyond the classroom, and suggested to teachers new ways to take advantage of educational resources in the local academic community.

Presentation on Mathematics and Architecture

On October 1, 1987, the collaborative sponsored a speech by Professor of Architecture Don Prowler. The session, scheduled from 3:00-4:30 p.m., was held in Dr. Prowler's office and studio at the University of Pennsylvania. In his presentation, Dr. Prowler demonstrated mathematical applications in architecture and addressed such topics as the mathematics an architect uses and how computers have changed the way an architect looks at the world. Because the talk was held in Dr. Prowler's office and studio, attendance was limited to ten teachers; only six attended.

While teachers reported that they enjoyed the presentation, a few expressed disappointment that they did not come away from the event with more specific uses of mathematics to bring back to the classroom. One teacher said, "It was informative for guidance purposes. I learned about architecture programs that exist for interested high school students. I was hoping to see more specific uses of math in architecture. On the whole, it was a worthwhile session." Another commented, "I was hoping to see more that I could bring back to the classroom, which would be premature anyhow since architecture is a graduate level program. I had hoped to see 'this is how we use math.'" The on-site observer reported, "It was intimate and interesting. We sat in Don Prowler's office and talked casually about architecture, about his background, about the school and how math can play a part in the problem-solving training of an architect. I think everyone enjoyed the discussion. . . . Because we were a small group, questions could be asked easily."

Infectious Disease Talk

On January 27, 1988, the collaborative sponsored an after-school program to enable science teachers to hear a team of doctors from the University of Pennsylvania Medical School discuss specific research procedures. Drs. Rob MacGregor, Fred Southwick, and Ian Frank spoke about their research on Infectious Diseases, including herpes-simplex virus and AIDS. Alcoholism was also discussed. During their presentation, the doctors addressed the constraints and considerations that impact medical research.

The seven teachers who attended the talk seemed to find it very worthwhile. One teacher commented, "I really enjoyed the talk. Each speaker approached the topic from a different vantage point. . . . This gives us a background for us to keep our students better informed." Another added, "I thought it was good. I liked the last speaker because he kept it to our level. The attendance was very low. I'd like to see other topics discussed, maybe more on our level. We do need this kind of information. It needs to be the right level and varied topics." A third teacher said, "I thought it was wonderful. I didn't exactly follow everything, but enough to be meaningful." The on-site observer reported, "The speakers were all well prepared and knowledgeable. Obviously, we did not have a huge attendance, but I heard no complaints. The attendees were all pleased. All thought the last speaker was best; he was less technical."

Science Software Review Session

On February 25, 1988, the collaborative sponsored a Science Software Review Session at the Regional Computer Resource Center (RCRC) at The Philadelphia College of Textiles and Science. All science teachers in the Philadelphia Public Schools were invited to attend. The session, which ran from 1:30-4:45 p.m., opened with an hour-long software review, during which teachers had access to RCRC's extensive collection of science software. This was followed by three 45-minute modules during which teacher-leaders guided participants through reviews of specific software packages, including *Playing with Science* (Sunburst), *Discovery Lab* (MECC), and *Oh, Deer* (MECC). Sixteen teachers and school administrators attended. Each teacher who participated received a copy of the computer programs *Oh, Deer* and *Discovery Lab*.

The teachers who attended felt that they learned about some good software packages, although some expressed frustration that their schools did not have computers that were compatible with the software.

One teacher said, "I thought it went well. I would have liked more teachers there. It was good." Another added, "For me it was useful. It is helpful for those who are computer literate. The programs could be used from 6th grade to 10th grade. . . . The module for the third year ecology was helpful." Another teacher said, "Most science departments do not have the facilities to make use of Apple software. As long as we are starved on hardware we have to be content with what we have." The on-site observer reported, "I thought this went very well. The teachers were involved in using programs. They were presented by several teachers who had used them in their classrooms. Everyone seems to have enjoyed the program."

Mathematics and Computers with Thomas Kurtz

On April 15, 1988, the collaborative sponsored a hands-on workshop using True BASIC Inc.'s mathematics software for the Macintosh, followed by a lecture/discussion with Thomas Kurtz, Professor of Mathematics at Dartmouth College and co-creator of the BASIC programming language. A workshop for department heads began at 1:00 p.m. and was followed by the lecture, which began at 2:30 p.m. Both events were held at Carver High School of Engineering and Science. All mathematics teachers in the Philadelphia Public Schools were invited to attend the lecture.

The twenty-seven teachers and administrators who participated seemed to feel that their time was well spent. One teacher commented, "A good event. It was extremely interesting to meet him and hear what he had to say." Another added, "The workshop was good. 'Hands on' is always a good way to learn something new or different." A third teacher said, "I found the talk interesting. It was nice to meet the man that was one of the originators of BASIC." The on-site observer reported, "It was lively and the participants were pleased. Good attendance for a Friday afternoon."

Geometric Supposer Network and Workshops

Supposer Network

As a result of a workshop that the collaborative hosted in April, 1987, mathematics teachers in three target high schools and one non-target high school pilot tested the Geometric Supposer in their geometry classes during the 1987-88 school year. The Geometric Supposer is a software package that enables students to construct and measure geometric figures. The software was provided by Sunburst through the Technical

Assistance Project. The pilot teachers are participating in an on-line national network of Supposer users that has been established by the UMC Technical Assistance Project at the Education Development Center.

On April 10, the collaborative sponsored a meeting at William Penn High School to allow teachers who are using the Supposer an opportunity to share their problems and successes. At the meeting, each of the ten teachers in attendance described their experiences with the software; one reported that her class was willing to do extra assignments in order to use it.

The exchange of information among the teachers seemed worthwhile. The on-site observer reported, "I think each teacher got something out of the meeting. The networking is good. The teachers were willing to help others start using the program."

Supposer Workshops

During the 1987-88 school year, the collaborative also conducted hands-on workshops on the Geometric Supposer during mathematics department meetings at six of the target schools, and for the school districts' Supervisors of Mathematics. In addition, a Supposer workshop was conducted for Lincoln High School students as part of the school's celebration of 100 years of American mathematics.

NCTM Standards Discussion

On March 5, 1988, the collaborative and ATMOPAV, the Association of Teachers of Mathematics of Philadelphia and Vicinity, co-sponsored a discussion on the *Curriculum and Evaluation Standards* for school mathematics being proposed by the National Council of Teachers of Mathematics (NCTM). All ATMOPAV members, as well as the broader mathematics community in the Philadelphia area, were invited to attend the meeting, which was held from 1:00-3:30 p.m. at Beaver College.

David Glatzer, Director of NCTM, presented an overview of the *Standards*, after which the participants met in grade-level discussion groups. Many of the twenty people who attended were supervisory personnel from the suburban schools. In general the participants seemed enthusiastic about the proposed *Standards*, as well as the opportunity to discuss them. One teacher said, "It was helpful to hear other reactions to the *Standards*. Some good suggestions came out of the group. The middle school group picked some of the same things to discuss as the elementary school group. Kids really need to come to middle school with better skills." Another commented, "It was very informative. There was a lot of enthusiasm. I am looking forward for ways to implement them in our school. It was worthwhile. The reactions were very positive." Another teacher was less optimistic, saying, "The program proposed is much too ambitious. A lot of training will be needed before we are ready." The on-site observer reported, "I found that few people had read the guidelines before they attended. There were real gaps between what they perceived and what is written. However, it was good that people are interested in finding out what NCTM is proposing."

Department Heads Luncheons

During the 1987-88 school year, the collaborative sponsored three lunches for the district's department heads. The first two meetings were co-sponsored with the school system's Division of Mathematics and all of the mathematics department heads in the Philadelphia School System were invited. The third luncheon, sponsored by the collaborative, was open to the heads of the mathematics and science departments in the nine target schools.

NCTM Standards Luncheon

On January 12, 1988, the collaborative and the school system's Division of Mathematics co-hosted a luncheon for the mathematics department heads of all the Philadelphia high schools to discuss the *Curriculum and Evaluation Standards* for school mathematics being proposed by the National Council of Teachers of Mathematics (NCTM). Dr. James Schultz, a professor of mathematics at Ohio State University and a member of the Commission who developed the *Standards* for grades 5-8, presented an overview of the *Standards* and led a discussion regarding their impact. Thirty-eight department heads attended the luncheon, which was held at the Adam's Mark Hotel.

The meeting was very successful. The department heads felt that the presentation was worthwhile and appreciated the opportunity to talk with their colleagues. Some of the department heads did express disappointment that the speaker was not able to discuss issues related to secondary mathematics.

One teacher commented, "The speaker was knowledgeable and appropriate. It is always a treat to have a luncheon. It fosters good feelings. It is also important to meet out of the school building." Another teacher said, "It was valuable. We got to discuss the proposed *Standards* and many of us would not have read through the NCTM publications had it not been presented. It would have been better to have a secondary education committee member. Even though he was knowledgeable, he could not answer our concerns and questions." Another teacher added, "I would have liked it better if we had a speaker who knew more of secondary math. He was engaging and well prepared. As always, the most important part was the exchange I had with my colleagues."

Department Head May Luncheon

On May 19 the collaborative hosted a luncheon for the heads of all the mathematics departments in the Philadelphia School District. Thirty-five department heads attended the luncheon, which was held in the Home Economics Suite of William Penn High School. The program included a report by Mathematics Education Director David Williams, and a discussion of the Technology Conference planned for September, 1988. In addition, a retiring department head was honored. The department heads enjoyed the opportunity to get together.

Department Head End-Of-Year Luncheon

On May 5, 1988, the collaborative sponsored a luncheon for the science and mathematics department heads from the nine target schools. Ms. Stetzer, the collaborative coordinator, and Dr. Ransom, the collaborative director, presented a review of the collaborative's activities during the year and a preview of the project's future. Thirteen department heads and school administrators attended the luncheon, which was held at the Williamson's Restaurant.

One department head commented, "I hope the collaborative continues to be as encouraging as it has been. As long as Sue [Stetzer] is at the helm, I'm certain it will." Another added, "Our school has really thrived with the collaborative. I think we'll have the impetus to continue." A third department head said, "It seems that the plans are made and will continue. I'm looking forward to next year." Another commented, "Sue has been wonderful. She has been very involved with our school. I hope everything will be as good in the future." The on-site observer reported, "People are a little apprehensive about the future of the collaborative. There is a lot of pride in the collaborative as it has been. I think everyone is looking forward to more involvement with the collaborative and hoping that not too much will change."

Access

During the 1986-87 school year, the collaborative established a network for teachers of Mathematics in Applications (MIA), a new third-year nonacademic mathematics course. The collaborative also initiated the publication of ACCESS to provide sample computer activities and resources to teachers. ACCESS is a mailing of public-domain and teacher-written software, accompanied by topic-related print materials. ACCESS materials were disseminated three times during the first year. Ms. Stetzer sent the initial ACCESS mailing, which included a disk and print material, to all high school mathematics department heads and all MIA teachers. Teachers were then asked to join the network by returning either a blank disk or one of software they had created, and/or worksheets they had developed.

During the 1987-88 school year, four volumes of ACCESS were published and disseminated. The October volume focused on problem solving and the organization of data; the January volume covered spreadsheets; the March issue discussed Project Face Lift, applications with sub-ordered tasks; and the May volume offered ideas related to probability and income taxes. The ACCESS network now has a core of twenty-five teachers who share materials and return disks.

Dues to Professional Organizations

For the second consecutive year, the collaborative purchased memberships in the local professional organizations--the Association of Teachers of Mathematics of Philadelphia and Vicinity (ATMOPAV) and the Philadelphia Secondary Science Teachers Association (PSST)--for the mathematics and science teachers in the target schools. The collaborative paid the full price of memberships for teachers in the new target schools, and half the membership fee for second-year participants who were willing to pay the remaining half. Membership benefits for both organization include newsletters and regularly scheduled conferences. Both organizations schedule their conferences after school and on Saturdays so professional leave is not a problem; attendance at these conferences has increased significantly because of the collaborative's support.

Grants

Professional Enrichment Grants (PEGs)

The collaborative awards Professional Enrichment Grants (PEGs) of up to $250 to high school mathematics and science teachers in the Philadelphia public schools to enable them to attend professional meetings, workshops, and seminars. During the 1987-88 school year, the collaborative awarded thirty-eight PEGs, approximately 75 percent of which went to teachers from the target schools, as they are given first priority in the application process. Recipients' departments are required to provide any classroom coverage that they feel is necessary; many of this year's PEG recipients used the award to attend the Key Math Leadership Conference, which is scheduled over a weekend and requires no in-school coverage. Teachers have also used PEG funds to attend the Pre-Calculus Conference at Rutgers University on January 13, 1988; the annual meetings of the National Council of Teachers of Mathematics and of the National Science Teachers Association; the National Education Computing Conference at Exeter; the fall ATMOPAV Conference at Villanora University, the Project T.I.M.E. (Teachers Improving Mathematics Education) Conference in California, MAA, the College Board Conference, and ICASE in Australia.

The teachers who were awarded the PEGs were enthusiastic about their experiences. They shared their new insights in department meetings, at local professional conferences, through the collaborative's monthly newsletter, and at meetings of department heads of mathematics and science. They have expressed concern about the difficulties of gaining professional leave to participate in professional opportunities. While Philadelphia School District policy supports the granting of professional leave, in reality the shortage of certified science and mathematics substitute teachers severely limits professional leave opportunities for many teachers.

PRISM Grants

PRISM has allocated approximately $100,000 to award to teachers or to groups of teachers to support innovative and experimental projects designed to enrich classroom experiences in mathematics and/or science. An individual grant may total up to $3,000. There is a great deal of competition for the PRISM grants. Collaborative Coordinator Sue Stetzer provided encouragement and consultation to teachers preparing grant proposals. Assistance ranged from discussing ideas for grants to arranging for word processing of the proposals.

During the 1986-87 school year, the collaborative helped high school mathematics and science departments apply for PRISM grants of up to $500 to purchase telecommunications equipment. Target schools that did not have modems requested and received grant money to purchase them. The modems arrived in fall, 1987, and the collaborative followed up on the PRISM grants by conducting several telecommunications workshops. The workshops, which were scheduled throughout the 1987-88 school year, were held for individual teachers at three target and two nontarget schools, as well as at departmental meetings at two target and two nontarget high schools.

Conferences

ATMOPAV Meetings

Fall Conference. The 1987 Fall ATMOPAV Conference was held Saturday, October 31, 1987, at Villanova University. The theme of the half-day meeting was "Many Magic Minutes Make Mathematics Meaningful," and the keynote address was delivered by David R. Johnson, chairman of the mathematics department of a suburban Milwaukee high school and author of the books "Every Minute Counts" and "Making Minutes Count Even More." More than 400 ATMOPAV members attended, including many collaborative teachers.

The teachers seemed to enjoy the conference. One teacher said, "I did a lot of networking. I enjoyed speaking to other teachers to find out what they were doing and discussing common concerns. It is always good to meet and exchange ideas. It helps to know problems you have are the same, and solutions can come from others." Another added, "Really one of the better conferences. I can't put a finger on the reason. There was a lot of enthusiasm." A section leader at the conference said, "I was surprised with the number of people who came. I was wondering if anyone would. I questioned if there would be that much concern or interest. I was very encouraged."

The on-site observer reported, "The meeting was well attended. The weather was wonderful, which could have helped, but the teachers really seemed to enjoy being there. There was a lot of networking. The teachers enjoyed the meeting, the section meetings, and workshops. Tremendous enthusiasm."

Spring Banquet. On May 10, 1988, ATMOPAV and the Bucks County Council of Teachers of Math (BCCTM) sponsored a spring banquet at Williamson's Restaurant in Morsham, Pennsylvania. Approximately 150 teachers attended. Dr. William Cole, noted mathematics educator from the University of Michigan, had been scheduled to speak on "Math Across the Curriculum" but at the last moment Dr. Cole had to cancel and was replaced by a language arts specialist Ms. Ann Anderson, a writer with Houghton Mifflin Publishers, who addressed, "Writing and Mathematics."

While the teachers enjoyed the opportunity to interact with their colleagues, they were disappointed in the presentation. One teacher commented, "I guess we are spoiled. Math people are such good speakers, we are used to better than this." Another commented, "It was enjoyable to see our colleagues that we don't have time to see." The on-site observer reported, "Unfortunately, ATMOPAV arranged for a speaker through a publisher. She was a language arts person and knew nothing about speaking to a group of math people. Everyone was happy about the dinner and socializing, but agreed that the speaker was uninformed and not too well prepared."

Mathematics Leadership Conference

The third annual Mathematics Leadership Conference, sponsored by the School District of Philadelphia, was held March 11-13, 1988, at the Quality Inn of Brandywine in Dowingtown, Pennsylvania. Approximately 230 key mathematics personnel from the school district, including teachers and administrators, attended. Sixteen collaborative teachers received Professional Enrichment Grants to attend the conference. Each participant participated in four workshops and heard two keynote speakers: former NCTM President Dr. Max Sobel speaking on "Motivational Materials for Monday Morning Mathematics," and Dr. Harold Weymouth of Rhode Island speaking on learning styles/teaching styles.

The collaborative sponsored a Saturday luncheon for its teachers who were attending the conference. Thirty-six teachers and school administrators attended and heard District Director of Mathematics David Williams discuss the NCTM *Standards*.

All of the teachers who were interviewed felt that both the luncheon and the conference were a great success. One teacher said, "There was wonderful camaraderie here and I felt special to be able to attend the conference and the luncheon." Another said, "Hearing Dave Williams discuss the guidelines was very good. The conference was wonderful. It's always good to hear what is working in other classrooms. This is the second conference I attended and I'm looking forward to next year's. I hope the collaborative can give PEGs again next year." A third teacher commented, "The collaborative has given me an opportunity to take part in events I never would have before. I really enjoyed the luncheon and meeting and talking to other people from other schools." Another added, "Keeping up with trends is something that all teachers need to do. To be able to have a retreat just to do this was great. I really feel grateful to the collaborative for this opportunity." The on-site observer reported, "This is the third year for this event. The collaborative sponsored a luncheon and also the attendance of about sixteen teachers at target schools through PEGs. The teachers attending were enthusiastic and thrilled with the conference. During the luncheon I heard people say they felt special several times. They did. The luncheon was a great way for teachers to network and discuss math ideas they are using, and to enjoy themselves. Dave Williams' remarks were a good addition."

Project TIME Conference

In February, 1988, the collaborative funded two teachers from one of the target schools to attend an NSF conference on implementing site-based change in mathematics education. The conference, which was held in Santa Barbara, California, focused on a successful site-based change model that stresses the importance of providing support for change. The model was developed by Project TIME (Teachers Improving Mathematics Education), which provides teachers with the knowledge and skills needed to implement a quality mathematics program; the project focuses on curriculum and instruction, on-site leadership, and the development of support systems. Both teachers were very enthusiastic about the conference and supportive of Project TIME. An article they wrote for the collaborative newsletter said, "We both believe that this project is very worthwhile and would be beneficial to our mathematics program here at Dobbins and perhaps throughout the school district." As a result of the conference, one of the teachers reorganized her classroom layout and teaching structure to emphasize cooperative rather than competitive learning. She also shared the national perspective on mathematics education that she had derived from the conference with the mathematics curriculum committee, and changed the structure of department meetings at her school to allow more input from each participant.

NCTM Annual Meeting

Twelve representatives of the Philadelphia Math Science collaborative attended the NCTM Annual Meeting held April 6-9, 1988, in Chicago, Illinois. Of the twelve, four received Professional Enrichment Grants to support their attendance. All four of these teachers felt that attending the conference was an exciting experience, although one of the teachers was frustrated that some of the sessions were overcrowded.

One teacher commented, "I think I made a mistake in going late and missing the first two days of the conference. I ended up only attending a few meetings. I found the meeting exciting and meaningful. The networking was wonderful. I got to talk to some people but not as many as I would have liked to." Another added, "It was a wonderful experience. I enjoyed the conference and the programs and sessions I attended." A third teacher said, "The rooms were filled to capacity. . . . The scheduling was poor. It was wonderful to hear the people who spoke. Perhaps some speakers could speak twice so that more of us could have the opportunity to take part." The fourth teacher, who is the on-site observer, said, "The attendees were enthusiastic, enjoying the programs and really wanting more. All said they'd go again. They loved the opportunity."

National Conference on Mathematics Reform and Teacher Professionalism

The Philadelphia Math Science Collaborative funded the project coordinator to attend the Mathematics Reform and Teacher Professionalism conference at the North Carolina School of Science and Mathematics in Durham, North Carolina, on June 23-24, 1988. The conference was designed to inform and guide the broader mathematics community in its effort to improve mathematics education at the precollege level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. The conference focused on helping educators to understand the need for change in mathematics education and to develop strategies for bringing about such change.

Collaborative Newsletter

The collaborative continued its monthly publication of *The Philadelphia Math Science Collaborative Newsletter* during the 1987-88 school year. The newsletter is distributed to the principals and mathematics and science department heads of all the Philadelphia high schools, as well as to all mathematics and science teachers in the nine target schools. Edited by Collaborative Coordinator Sue Stetzer, the newsletter announces upcoming collaborative events, as well as events of interest to math and science teachers sponsored by other organizations in the school district; provides updated information about the collaborative; presents topics of interest to mathematics and science teachers; and serves as a vehicle for teachers to express their views relating to mathematics and science education. The first page of each newsletter lists a calendar of events for the month.

In addition to the collaborative newsletter, information about the collaborative is published in a variety of other newsletters that are distributed to Philadelphia teachers. These include "Continuum" and "Continuum Update," the PATH/PRISM publications, the PSST and ATMOPAV newsletters, and the newsletter published by the School District of Philadelphia.

E. Observations

Project Management

The concept of an in-school collaborator is evolving in Philadelphia and is emerging as an effective model for meeting the professional needs of the city's collaborative mathematics teachers. Coordinator Sue Stetzer has been the key in making the collaborative work and in developing what an in-school collaborator can do; at this point, in fact, the role of an in-school collaborator is defined by what Ms. Stetzer does. Currently, this includes spending time in the schools talking to teachers and supporting their needs and wishes; meeting with groups to plan and coordinate activities; and networking among teachers, business people, and academicians. Some of these responsibilities overlap those of the district mathematics supervisors; however, subtle differences exist between Ms. Stetzer's activities and the generally accepted role of a mathematics supervisor. One fundamental difference is that the role of an in-school collaborator is to support teachers and to help them do their work, while a supervisor generally is more directive and interested in ensuring that teachers follow district mandates.

This year, the Philadelphia collaborative has made efforts to determine whether the concept of the in-school collaborative is one that can be reproduced by others and whether it provides a viable model for working with teachers. Conditions in Philadelphia are conducive to the success of the in-school collaborator system. The city offers a multitude of resources, which means that the collaborator can spend her time connecting available resources rather than generating new ones. Ms. Stetzer has worked as both a teacher and a department head, experiences which provide the basis for a solid rapport with both teachers and administrators. Her personal style of working with people has helped; Ms. Stetzer is very comfortable working one-on-one, rather than through committees or by directing others. Ms. Stetzer has said, "I do not delegate very well." Thus, there are conditions in Philadelphia that have fostered the concept of in-school collaborator, but this does not suggest that the concept will work in all districts.

In fact, it appears that there are at least five functions that an in-school collaborator must fulfill; the first function is *personal attention*. Ms. Stetzer spends the majority of her time in schools talking and working with teachers. This constant interaction fosters collegiality among teachers, and between teachers and the collaborative. A second function is *service*. The mathematics and science teachers in the target schools can use Ms. Stetzer as a resource, whether to identify a guest speaker or to connect with another teacher who is familiar with some particular set of materials; teachers know that Ms. Stetzer will do her best to satisfy their requests. A third function is *knowledge*. Ms. Stetzer is very knowledgeable about the curriculum, school mathematics, and the use of technology in the classroom. She is also familiar with the dynamics of the district and how it works, an expertise that allows her to draw upon district resources. Finally, Ms. Stetzer knows the community and is able to take advantage of opportunities and resources available through supporting agencies, businesses, and higher education. A fourth function is *leadership*. Ms. Stetzer has a clear vision of what teaching and the collaborative should be. She is a skilled moderator who can run meetings and motivate people to reach conclusions and make decisions. She has confidence in herself, yet recognizes her limitations. A fifth function is *perseverance*, which involves following up on school visits and conversations with teachers to ensure that plans are realized and tasks are accomplished.

It remains unclear whether the concept of the in-school collaborator model in Philadelphia has been the result of a single individual's dynamic personality, or whether it is a position that others can fulfill with similar success. As PRISM assumes control of the collaborative and its future development and direction, this is a question that must be addressed. What *is* apparent is that the collaborative has developed a model for working with teachers that may be applicable to the district mathematics office or to some other collaborative site. It also appears that having the collaborative funded from outside of the district has provided the opportunity to try different approaches, which has resulted in the concept of an in-school collaborator.

The administrative changes of PRISM and PATH, the collaborative's umbrella organizations, have had very little immediate effect on the collaborative. In the long term, however, the effects could be profound. PRISM is an administrative organization that focuses on fund raising and on projects that involve teachers, students, and curriculum development. The collaborative, on the other hand, is characterized by service and networking, in which personal dynamics are fundamental. A key question is whether the collaborative can retain its character under the PRISM structure. Several indications suggest that this is possible. In the three-year plan outlined by the new PRISM director, it is the collaborative's role to provide outreach. This suggests that the PRISM administration does view the collaborative as different from its other projects. A plan for a PRISM representative to shadow Ms. Stetzer during the 1988-89 school year as a means of understanding what she does also makes sense. Another question for long-term consideration is whether the collaborative will affect PRISM's approach.

The advisory board structure of the collaborative changed during the year to better address the needs of the in-school collaborator model. The single executive board was not responding in a way that the collaborative administration felt was the most helpful; board members seemed reluctant to address the issues and to give the coordinator the support that was needed. The new structure, in which three groups have each been assigned a specific charge, has worked well. Each group understands what it is to do, and each group is composed of people who share similar goals and interests. In addition, the new structure draws more people into direct and ongoing collaborative involvement. The revised structure reflects a maturation in the collaborative and a sorting out of what is important to its survival and success.

The collaborative's strategy of focusing initially on six target high schools and then increasing this number by three or four a year seems to have worked thus far. This strategy also seems critical to the success of the in-school collaborator concept because it has allowed the collaborator sufficient time to give individual attention to each of the schools. It also has provided active support to teachers to join professional organizations, write grants, and develop their own programs. As more schools join the collaborative, the level of personal attention to the more established schools in the project decreases. There is a question of how the strategy will work with the inclusion of the third wave of schools and whether the original six schools are ready to continue to work independently.

Collaboration

Collaboration in the Philadelphia Math Science Collaborative has occurred primarily among teachers. Because the collaborative has provided support and has facilitated networking, teachers have communicated more both within and between schools. As one teacher reported, "I am now communicating more with other teachers and learning from them." Another teacher said, "We talk more with each other. We have been encouraged and we do a lot of sharing." The collaborative has fostered this interaction through the newsletter, which keeps teachers informed of events; through meetings; through the creation of networks; through grants that provide teachers the opportunity to attend meetings and conferences; and through the work of the in-school collaborator, who encourages such broad-based communication.

Collaboration has impacted upon teachers and departments in a variety of ways. Teachers in some mathematics departments shared a solid rapport prior to their collaborative involvement; the individual characteristics of the department head seems to play an important role in determining the extent of such rapport. Where it exists, collaborative involvement has enabled teachers to attend special activities and to bring back information and new enthusiasm to their department colleagues. In departments where communication among members was not as strong, the collaborative has been more proactive in increasing the interaction among teachers. One benefit of the in-school collaborator is that she is able to identify and attend to these particular needs of individual departments.

Developing networks has been one of the ways the collaborative has helped to get teachers talking with one another. The Mathematics In Application and the Geometric Supposer networks have both resulted in teachers communicating with one another and sharing ideas. Some of this interaction has occurred over modems. "I'm all over the modems talking to people all over the country," was the response of one teacher when asked to describe how the collaborative has helped her form relationships with other teachers. The monthly newsletter also is an important tool for keeping teachers informed as to what is happening. "I appreciate the monthly calendar and ACCESS is very useful," said one.

The interaction between science and mathematics departments within a school also has varied by school. In one school, the science and mathematics teachers are working together to identify the points at which concepts covered in mathematics class correspond to information being addressed in science classes. In another school, the science and mathematics department heads have begun to work together, but at this point there has not been any interaction among the teachers. In a third school, very little interaction has taken place between the two departments because they are located in different parts of the school building. In a fourth school, a teacher reported a significant change: "There have been changes within our school and our department. We have had joint meetings with the science department." At this stage in the collaborative's development, the collaboration among mathematics and science departments has had mixed success.

The collaborative's efforts to develop interaction between teachers and those in business and higher education have consisted largely of the leadership provided by the three advisory committees and by individual presentations to departments. During the year, teachers serving on the committees, particularly the Steering Committee and the Program Planning Committee, have interacted with those from the other sectors in addressing important collaborative issues. Business and higher education representatives have been invited to make presentations at department meetings or programs to which all collaborative teachers are invited. Committee members from higher education have begun to be more diligent about informing the collaborative about campus activities that may be of interest to teachers. Committee members from the business community have suggested that they are interested in helping in any way they can, but that they would like educators to make explicit requests rather than simply asking, "What can you do for us?"

This committee framework also provides teachers the opportunity to interact with school district administrators. For example, the issue of release time for teachers was raised in a Steering Committee meeting. One teacher suggested that district policy prevented teachers from getting release time to attend professional meetings. The district administrator clarified the issue, informing the committee that there was no particular policy but that finding certified substitutes to teach mathematics was a problem. The Steering Committee meeting provided a forum for the discussion.

A dinner meeting held at Temple University on December 17, 1987, of fifteen representatives of higher education, district administration, and teachers is one indication of the increased interest of those from higher education in the collaborative. The purpose of the meeting was to brainstorm about ways to bring mathematics and science teachers together. Some ideas were generated, but more importantly, people from all sectors worked together to address an issue. At this point in its development, the collaborative has done well to increase the interaction among teachers and has made progress in soliciting the involvement of those from business and higher education.

Professionalism

The collaborative has been instrumental in involving teachers in professional activities, including their attendance at professional meetings, and their membership in the local mathematics teachers' organization. It is too early to tell whether the strategy of paying the full fee of a teacher's ATMOPAV membership the first year, half the second year, and none the third year will mean that more mathematics teachers will be members over the long term. What is apparent is that teachers seem to be more aware of the advantages of membership in professional organizations and more interested in attending meetings. One department head explained, "It (the collaborative) has helped to focus the teachers on the importance of attending professional meetings and keeping abreast of opportunities available." Another teacher reported as a significant change that ". . . in my school we are more aware of a greater organization of math teachers."

The availability of Professional Enrichment Grants has been a major impetus in the increase in teachers' participation in professional activities and grants. Teachers' participation is then complemented by the collaborative's efforts to help teachers acquire the materials and equipment they have seen demonstrated. Thus, teachers are able to take full advantage of their professional experiences. One teacher reported, "Last year I went to the Key Math Conference at Host Farms on a PEG. I learned LOGO and incorporated it into my class." A second teacher commented, "The collaborative has had a real positive effect. I went to the Key Math Conference on a PEG and saw a video using an interface card. I spoke with my department head, who spoke with the vice principal, who gave her $750 for the equipment."

The collaborative has also helped to reduce teachers' isolation from one another and from new professional advances, and has fostered in them a greater perspective of what is happening nationwide. "We are more aware of technology because of (the collaborative)," said one teacher. "We have become more aware. We are less isolated than before." Another teacher commented, "I am getting a bigger view--how we in Philadelphia fit into the system--of the country. All the problems we are having are national. The same problems we are encountering are happening other places. The solutions should be national."

Other teachers feel more positive about teaching. "Many teachers were very negative, but now people are willing to try new things. People have a more positive attitude," says one teacher. "I think there is more respect for math teachers," commented another. And a third teacher reported, "There is more enthusiasm and more support (for daily teaching) as a result of our being part of the collaborative."

While some teachers report that the collaborative has had little effect on their involvement in school-related decision-making procedures, some believe the collaborative has improved their professional status. In response to a question about the most significant changes that can be attributed to the collaborative, one teacher wrote, "A feeling of empowerment is the greatest change." It is clear, then, that within the context of a district-mandated curriculum and grading program, the collaborative is affecting teachers: they are becoming less isolated and more enthused about their work. They are becoming more involved in professional activities and more informed about resources and opportunities. What must be examined are the effects on the professional lives of those teachers who have been participating in the collaborative for more than two years and the effects on all teachers as the transfer of the collaborative to PRISM takes place.

Mathematics Focus

The collaborative has focused its efforts and attention on the use of technology in the teaching of mathematics. This is apparent in the networking among teachers who share software and ideas for the Mathematics in Applications courses. It also is evident in the increased number of teachers using the Geometric Supposer. The in-school collaborator has been instrumental in establishing the networks and keeping them going. The networks seem to be having an effect: "The ACCESS network has made teachers more aware," said one teacher. "I am helping others with their awareness of technology. I was able to influence my principal to buy more technological equipment." Another teacher reported, "I found the material used for MIA (ACCESS) extremely helpful." One department head said, "I am more aware of opportunities to use technology and direct my teachers in the use of technology in the class. . . ."

Another collaborative focus this year has been the NCTM *Curriculum and Evaluation Standards* and other changes in mathematics education. The collaborative was instrumental in bringing together teachers to discuss the *Standards* as well as other national trends and developments. One teacher reported, "It (the collaborative) has given me the 'wherewithal' to be current. I am more aware of the changes taking place in math education. It has had an enormous effect on the school." Another teacher commented, "It (the collaborative) has enlightened me as to new approaches." At this point, teachers seem aware of the *Standards*, but unsure as to their relevance or importance. One teacher commented, "I have read the national *Standards* written by NCTM. 'The current trend' (referring to the *Standards*) is the status quo." According to this teacher, the *Standards* simply recommend what is already happening in Philadelphia.

There is some variation in mathematics focus among the target schools because of the district's strong emphasis on in-school activities. The in-school model has evolved, at least in part, in response to the strong commitment to the individuality and uniqueness of each department. Ms. Stetzer worked with one department in the area of problem solving, with other departments in the use of technology, and with other departments in the area of mathematical applications. Another influence on the mathematics focus of a department is the aggressiveness of the department head. At one school, a department head has acquired grant money to buy software and equipment for the mathematics department. At another school, the department head was not as interested in the use of technology; it was his view, for example, that since calculators are not used on district tests it is not so important for students to use them. At another school, a change in department heads has influenced department interests; during 1987-88, the department presented a series of workshops on problem solving, and teachers became more comfortable with their own problem-solving skills. However, with a change in department head, there was no real follow-up on problem solving and a new emphasis on study skills was adopted.

It is clear, then, that several factors determine the mathematics focus of the collaborative and its target schools. One is the collaborative coordinator and her interests and expertise. Another is the vision, interest, and motivation of the department heads. A third is the district and the curriculum it mandates. A fourth is national trends, both in technology and in the mathematics curriculum. All of these have had an effect on the collaborative and its mathematics focus.

F. Next Steps

In 1988-89, the Philadelphia Math and Science Collaborative will begin its transition from its current offices in the Franklin Institute to its new position under the umbrella of the PRISM organization. Sue Stetzer will be "shadowed" by a PRISM representative, with the expectation that this person will assume the position of collaborative coordinator. The number of target schools will be increased by four during the year, with an ultimate goal of including all twenty-one comprehensive high schools in the district. The activities of the collaborative during 1988-89 will continue as they have in the previous years.

SUMMARY REPORT:
PITTSBURGH MATHEMATICS COLLABORATIVE

by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Pittsburgh Mathematics Collaborative for the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Pittsburgh Mathematics Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM Conference in April, 1988, in Chicago; survey data provided by teachers; and one site visit by the staff of the Documentation Project.

PITTSBURGH MATHEMATICS COLLABORATIVE

A. Purpose

Six goals articulated in the Pittsburgh Mathematics Collaborative's initial proposal continue to provide its focus. The project's goals are:

1. to overcome teachers' isolation and to increase opportunities for interaction;
2. to educate the community about the professional nature of high school mathematics teachers;
3. to enhance teachers' knowledge base of mathematics applications;
4. to provide opportunities for professional self-enhancement;
5. to provide opportunities for teacher recognition; and
6. to provide time for teacher interaction, work, and professional development.

The long-range goal of the collaborative, as stated in the 1986 proposal for continued funding, is the institutionalization of a set of structures and processes that will continuously foster teacher professionalism and will be decreasingly reliant on external administration and facilitation. In light of this goal, collaborative activities are guided by a vision that by 1990, Pittsburgh will have:

1. an energized secondary mathematics faculty, deeply involved in mathematics curricular and policy issues, and continuously interacting with the larger community;
2. a community that is knowledgeable about secondary mathematics issues and appreciative of secondary teachers;
3. a series of mechanisms in place to promote exchange and interaction among teachers and community leaders in business, industry, and higher education; and

4. a public more aware of the importance of mathematics in students' educational development and in adults' professional lives.

B. Context

The city limits of Pittsburgh encompass 55.5 square miles and a population of nearly 425,000 people. The population of the metropolitan area is 2.5 million. In the city of Pittsburgh, 74 percent of the population is white, 24 percent is black, and the remaining 2 percent is comprised of other ethnic groups, including Asians and Hispanics.

Dr. Richard C. Wallace, Jr., is completing his eighth year as the superintendent of the Pittsburgh Public School District. During the 1987-88 school year, Dr. Wallace signed a contract extending his tenure to 1990 with an enhanced retirement package and a salary increase. These contractual concessions were granted by the Pittsburgh Board of Education when it became known that Dr. Wallace was one of eight candidates being considered for the position of Chancellor of the New York City schools. He subsequently withdrew his name from consideration. The Pittsburgh Board of Education is composed of nine members. The district has one deputy superintendent and three associate superintendents. The Division of Mathematics, directed by Dr. Diane Briars, is one of thirteen divisions in the Department of Curriculum and Program Management. In the Division of Mathematics, there are five supervisors for grades K-12; during the 1987-88 school year, one of these positions was vacant.

The seventy-nine schools in the district include twelve high schools (grades 9-12), and sixteen middle schools (grades 6-8). The district's K-12 student population has approached 40,000 for the past three years. While enrollment has declined slightly during each of the last five years, with decreases ranging from 2.4 percent to .34 percent, an increase in student enrollment is anticipated for the 1988-89 school year. Of the total student population, 52 percent is black, 46 percent is white, and 2 percent is Asian, Hispanic or American Indian. The percent of black high school students ranges from 99 percent in one school to 30 percent in another. Of the 12,896 high school students, 82 percent were enrolled in mathematics during the 1987-88 school year, with black students comprising nearly 50 percent of that population. On the California Achievement Test this year, 73 percent of the secondary students scored above national norms.

Of the 114 high school mathematics teachers, 37 percent are women and 63 percent are male. Ten percent of the high school mathematics teachers are black and 90 percent are white. All of the teachers are certified to teach mathematics and nearly all, 98 percent, are tenured. For the 1987-88 school year, only one new teacher was hired to teach mathematics. During the year, the American Federation of Teachers union negotiated a new four-year contract beginning September 1, 1988. When the contract was announced, it was credited with making the Pittsburgh teachers among the best paid urban school district teachers in the nation. As outlined in the new contract, the teachers will work 183 teaching days and six record-keeping days. For the 1987-88 school year, the union and district agreed to decrease each class period by one minute so the teachers could meet in departments for 90 minutes after school on Wednesday afternoons. These changes came about through the cooperative efforts of Dr. Wallace and Union President Mr. Al Fondy and by a vote of the teachers. Half of the weekly period comes from the teachers' own time. This staff time was labelled TIP, Teacher Interaction Period, and was used by teachers to discuss curriculum, use of computers in teaching, and other such topics. No administrator has the right to say what will take place during the TIP. This time falls entirely within the jurisdiction of the department chair, who organizes, plans, and uses it as professional development time.

The Pittsburgh Public School District operates on an annual budget; the proposed budget for 1988 was $275.685 million, a 2.5 percent increase over the 1987 level. The 1988 budget will not require a tax increase, however, as it was accompanied by such cost-saving measures as reducing central office personnel by 10 percent during 1988. The budget is financed by approximately 58 percent local funds, 33 percent state funds, and 9 percent funds from other sources.

The district focused on several initiatives during the 1987-88 school year. As a means of increasing enrollment in secondary mathematics and science courses, the district made efforts to improve the quality and pacing of these courses at all levels. Other priorities included continued efforts to evaluate district personnel more effectively and to reduce the dropout rate. Toward these ends, the district asked each high school to develop a Center for Excellence, which articulated the school's particular focus for the year. In some high schools, a committee of teachers and administrators established goals. One high school, for example, established a mentor program. Another focused on facilitating the transition from junior high school to high school.

The school district is considering whether to restructure its computer science program. Teachers are concerned that computer science may be taught exclusively at Brashear High School; this would mean that all students in the computer science program would have to transfer there. Teachers also are concerned about supervision in the computer labs and the use of Pascal instead of Basic as the district's programming language. At present all ninth grade students can take one computer course in their home schools. All subsequent computer courses will need to be taken at Brashear High School.

Another local incentive program has been initiated by Burger King and the Pittsburgh Press; under the program, all students in the Pittsburgh Public Schools who maintain a grade point average of 3.5 or better will receive two free tickets to a Pittsburgh Pirates baseball game.

Several other links in the Pittsburgh area are relevant to collaboration. The University of Pittsburgh conducts a tutoring program for students at the School of Science and Mathematics. Western Pennsylvania has an active Mathematics Council open to teachers' participation. In April, the City of Pittsburgh received a $12.5 million grant from the Annie E. Casey Foundation targeting students at risk. Pittsburgh was one of five cities in the country to be awarded a major grant from the foundation, and the only one to receive the maximum grant. The money will be received over five years, with the city responsible for obtaining matching funds. Collaborative Coordinator Dr. Leslie Salmon-Cox and the district's associate director for mathematics, Diane Briars, submitted a grant to the National Science Foundation for a middle school mathematics project. The collaborative will receive $438,000 to provide a staff development program for middle school teachers. The district is sharing the cost of the project by contributing an additional $386,000.

The Westinghouse High School in Pittsburgh houses the district's Science and Mathematics (SAM) Program in which students divide their instructional time between mathematics and science. The relationship between the two subjects is emphasized. The high school also has a program in which retirees from business come to the mathematics classes to tutor students.

C. Development of the Collaborative

The Pittsburgh Mathematics Collaborative continues to operate under the direction of its coordinator, Dr. Leslie Salmon-Cox. The original assistant coordinator, Dr. Martina Jacobs, left the collaborative in March, 1987; one month later, Ms. Barbara Bridge was appointed. Ms. Bridge splits her time between the collaborative and the Partnerships in Education Program (PIE). The school district's director for mathematics, Dr. Diane Briars, also is actively involved in the collaborative administration. The on-site observer is Rosemarie Kavanagh, a retired mathematics teacher. Major responsibility for the operation and direction of the collaborative is shared by its Executive Committee, the Department Chairs' group, and the Steering Committee.

Executive Committee

A group comprised of Dr. Leslie Salmon-Cox (Pittsburgh Mathematics Collaborative), Ms. Barbara Bridge (PMC and PIE), Dr. Diane Briars (Pittsburgh Public Schools), Ms. Nancy Bunt (Allegheny Conference on Community Development), and Ms. Jeanne Berdik (PIE) meets monthly to review collaborative activities and plans. This group, which meets the first Tuesday of each month, is referred to as the "First Tuesday Committee." By meeting regularly, the committee facilitates the coordination of the collaborative's major resource components, particularly in terms of establishing a link with the school district.

Curriculum and Policy Advisory Committee for Secondary Mathematics (Department Chairs' Group)

The mathematics department chairs, who met only rarely prior to their collaborative involvement, have evolved into a strong group, one which has successfully assumed its role as the Curriculum and Policy Advisory Committee for Secondary Mathematics. The chairs met monthly, excluding July, for the past year. At the meetings, which last for two to three hours, the chairs plan and devise policy regarding all aspects of secondary mathematics education. Both Drs. Leslie Salmon-Cox and Diane Briars have input into the agenda.

During the 1987-88 school year, the group produced a Secondary Mathematics Placement Guide for counselors to use in advising students on the sequence of mathematics courses they should be following. The development of this guide was accompanied by a discussion of what constituted a semester course. The committee also addressed the district's testing program and met with a representative of the district's testing office to express its concern that new test items should be either written or identified. The group also asked to have input into any changes made on the mathematics tests.

Another topic addressed by the Curriculum and Advisory Committee was the certification of department heads as instructional teacher leaders. The group met with Mr. Al Fondy, president of the Pittsburgh Teachers' Union, to talk about the implementation of such a program and the need for knowledge of mathematics content to play a more important role in the teacher evaluation process. The committee also discussed the need to alter the evaluation form to be used by the instructional teacher leader to allow the leader more leeway in discussing a particular teacher's needs, and the use of TIP time and how it could be used more effectively.

Frequently, written materials are shared at the meetings, including articles from professional journals or more informal sources. The department chairpersons share information among themselves. Each chair, in turn, is responsible for planning the Wednesday after-school departmental meeting time that occurs weekly from October to May, disseminating information to the other teachers in the department, and bringing the teachers' concerns to the Department Chairs' Group meetings for consideration. This process is one means by which all teachers can have input into decisions and learn about collaborative activities as well as district issues.

Steering Committee

The Steering Committee is comprised of twenty-seven members, including representatives from the business and university communities, the school district, and the funding organization. The committee's 1987-88 school year meeting was held April 19. At that meeting, which was attended by fourteen committee members, three teachers and the director of mathematics reported on activities in which they had been involved through the collaborative. One department chair spoke about his renewed interest in professional mathematics education organizations and his increased participation in professional activities. He spoke about the Department Chairs' Group, as well as other collaborative initiatives, and said that the formation of this group had made an extremely positive difference in the lives of mathematics teachers. Another teacher spoke about the Computer Training for Mathematics Teachers Group, an activity funded by the Ben Franklin Partnership Program. He reported that members of that committee are so highly motivated that they network with one other in the evenings and on weekends to discuss programming problems. The third teacher discussed the involvement of teachers in the redesign of curricula and focused on the effort to incorporate real-life problems into the curriculum. Dr. Briars discussed the NCTM *Curriculum and Evaluation Standards*. The committee also discussed possible collaborative activities and Dr. Salmon-Cox talked about writing the permanence proposal.

D. Project Activities

During the 1987-88 school year, Pittsburgh's secondary mathematics teachers were offered the opportunity to participate in a variety of activities sponsored by the collaborative. The collaborative also helped teachers to develop and submit applications for the Professional Enrichment Grants offered through the Allegheny Conference Education Fund. These grants allowed teachers to take advantage of professional opportunities offered by other organizations, including professional conferences.

Occasions for Collegiality

Kick-Off Party

A party to kick off the new school year was held at Dr. Leslie Salmon-Cox's home on Saturday, September 5. The mathematics department chair from each high school, the district's director and supervisors for mathematics, and the on-site observer were invited, along with their spouses. About half of the thirty people who were invited were able to attend.

Dinner Meeting

On February 18, the collaborative sponsored a dinner meeting for mathematics teachers at the Sheraton Hotel. Dr. Edward Silver, formerly of San Diego State University and now with the University of Pittsburgh, addressed the topic, "Emerging Vision of Mathematics Education." In his presentation, Dr. Silver emphasized the importance of problem solving, and stressed that teachers must help their students develop communication and reasoning skills that encompass conjectures, argumentation and formal proof. The evening was planned by a committee of teachers and the assistant project coordinator. Teachers paid $15 to attend. One of the purposes of the dinner meeting, which was the first such event for the collaborative, was to determine whether teachers would be willing to pay to attend an enrichment activity.

The thirty-eight teachers and supervisors who attended responded positively and agreed that it was a pleasant social evening in a beautiful setting with an excellent meal. Most of the teachers, however, had heard Dr. Silver speak before, and felt that they did not learn anything new. Some interest was expressed in inviting a teacher to speak at the next dinner meeting to address some of the problems that teachers face daily. The favorable reaction to this first dinner meeting was very encouraging.

Wine and Cheese Reception

The final event of the school year was a wine and cheese reception on June 1, 1988. All Pittsburgh secondary and middle school mathematics teachers were invited to attend the event, which was held at Grand Concourse Station Square. Mr. Bill Zlatos, the education writer for the Pittsburgh Press, spoke on newspaper coverage of education, e.g., what makes a good story. The eighty teachers who attended the event were impressed with the hospitality and the speaker.

Curriculum Development

In addition to the Department Chair's Group, which is an official Curriculum and Policy Advisory Group that meets monthly to plan and devise policy regarding all aspects of secondary mathematics education, two teacher committees met regularly through the year to discuss the mathematics curriculum.

The General Mathematics Redesign Group

In response to a 1986 state law that increased high school mathematics requirements from two years to three, the Pittsburgh School District with the support of the collaborative established a committee of five teachers and a supervisor to determine the content of that third year. Since its inception, the committee's task has been extended to involve redesigning the entire three years of what is now considered General Mathematics. The committee met monthly throughout the 1986-87 school year and engaged in curriculum writing over the summer, supported in part by the collaborative. By August, 1987, they had completed the redesign of the first year of general mathematics.

The committee continued to meet frequently during the 1987-88 school year. They identified the goals for the general mathematics curriculum in light of the new NCTM *Curriculum and Evaluation Standards.* As a result, the committee decided to create a course, "Problem Solving I," that introduced techniques in problem solving. In April, the committee met to make a recommendation on a new general mathematics textbook. Instead, the committee agreed to delay the decision in hopes that materials more compatible with its goals would become available. Curricular materials, including activities for the new course requiring problem solving and data analysis procedures, were compiled from more than twenty sources. In the 1988-89 school year, the course will be pilot-tested and, in the following year, will be adopted system wide with possible revisions. Curricular development will continue for Problem Solving II and III. The new courses will be designed as stepping stones toward an algebra course.

The Computer Training Group

In August, 1986, the Pittsburgh Mathematics Collaborative received a $20,000 challenge grant from the Pennsylvania Ben Franklin Partnership Program to train a select group of secondary mathematics teachers to become computer literate. Over the course of the 1986-87 school year, ten teachers were trained to use computers to teach mathematics. They spent five days during the summer of 1987 becoming familiar with selected software and designing lessons to integrate it into the curriculum.

The teachers continued to meet monthly during the 1987-88 school year to share their reactions to software they had reviewed, to design instructional modules for the training of additional teachers, and to create guidelines for the use of computers in mathematics classrooms. The group also shared ideas regarding programming and other computer issues.

In April of this year, Dr. Leslie Salmon-Cox wrote another proposal to the Ben Franklin Partnership Program to continue the Computer Training Group. The grant was approved and the group will continue for its third and final year.

In-Service Programs

As part of the district's in-service program, collaborative teachers devote a half-day of in-service in the fall and again in the spring to a session directly related to the goals of the collaborative. Teachers all attended a district-wide in-service in November, 1987.

October In-Service

The collaborative and the school district co-sponsored an in-service workshop on October 20 at Peabody High School for all of the mathematics teachers from Peabody, Westinghouse, Capa, and Allderdice high schools. Similar workshops were held on October 6 at Brashear High School for teachers from South, Carrick, Brashear and Letsche, and on October 22, at Perry, for teachers from Perry, Langley and Oliver high schools. At the workshops, Dr. Diane Briars described trends in mathematics education both locally and nationally. The NCTM *Curriculum and Evaluation Standards for School Mathematics* were presented and discussed. In addition, Dr. Leslie Salmon-Cox reviewed the work of the UMC Collaborative project.

City-Wide In-Service

On November 4, a city-wide in-service was held at Brashear High School for all secondary mathematics teachers in the Pittsburgh Public Schools. The in-service was designed by the department chairs at Brashear and Oliver high schools. Several sessions were offered--all presented by teachers--and teachers could choose to attend two. Several of the presenters spoke about opportunities that had been provided by the collaborative--e.g., the computer group made presentations on computer use in mathematics classes, and the teachers who had traveled to North Carolina spoke about what they had learned there and about the course they would offer the following summer.

January In-Service

An in-service was held on January 26, 1988, at Peabody High School and, again, several different sessions were offered all with teachers as the major presenters. All of the high school mathematics teachers attended.

Math Intensive Partnership Program

In order to encourage increased rapport between business, industry and the secondary mathematics teachers in the city schools, the collaborative has encouraged business and education representatives to form individually defined math-intensive partnerships. The first such partnership was established between PPG Industries and Langley High School, which had enjoyed a working relationship that resulted from the Partnerships In Education (PIE) program. A committee consisting of a representative from PPG, Langley's principal, the mathematics chairperson, the PIE coordinator and the collaborative's coordinator agreed to establish a tutoring program for mathematics students as the partnership's math-intensive project. The mathematics chairperson was responsible for surveying mathematics students to determine whether they were interested in being tutored and, if so, when they would be willing to attend tutoring sessions. PPG's representative was responsible for placing an article recruiting employee volunteers in the company newsletter. Student response was overwhelming. So many students requested help that the department chair was forced to limit the tutoring offer to those students enrolled in Algebra I. PPG experienced a more limited response from its employees, with only four volunteers agreeing to act as tutors. Tutoring began in February, with two-hour sessions scheduled every other Saturday through March. Three to ten students participated in each session. Although the program was implemented on a limited scale, the department chair has expressed great enthusiasm for its results and hopes to continue it next year.

Rather than limiting the number of partnerships to those established through the PIE program, the collaborative's assistant coordinator sought out partnerships for mathematics departments on an as-needed basis. Initial attempts have been met with mixed success and the partnership tutorial program with PPG is considered a pilot.

Professional Enrichment Grants

Professional Enrichment Grants for high school mathematics teachers were made available through the Allegheny Conference Education Fund to provide teachers with an opportunity to attend professional meetings, workshops, and seminars; to consult with fellow teachers and colleagues in the private sector; and to investigate areas that can enhance their professional development. Individual grants may total up to $300. Eleven teachers received grants to attend various professional association meetings and workshops.

National Workshops and Conferences

NCSSM 1987 Summer Workshop

The collaborative sent three teachers to the North Carolina School of Science and Mathematics (NCSSM) July 5-17 to attend a pre-calculus curriculum workshop sponsored by the Carnegie Corporation. The course, which stressed an applications approach to the study of pre-calculus, covered six modes of mathematical thought: geometry, data analysis, probability and statistics, mathematical modeling, computers, and finance. The teachers pilot-tested the material in their classrooms and returned to NCSSM for two days in January to discuss their findings. In the summer of 1988, the three teachers will hold a one-week course to train district teachers in the use of these materials.

Exeter Mathematics and Computer Conference

The collaborative and EDC each sponsored a collaborative teacher to attend a five-day conference at Exeter Academy in New Hampshire during the summer of 1987. At the conference, teachers viewed a wide range of software available for use in the mathematics classroom and heard presentations by software developers. One of the two teachers from the Pittsburgh collaborative is currently working on software development in conjunction with Carnegie Mellon University, and presented a discussion of artificial intelligence in which he demonstrated a geometry proof tutorial on the MacIntosh computer. This was done twice, once at a Geometry Conference at Syracuse University during June, 1987, and again at one of the meetings of the Computer Training Group during the 1987-88 school year.

National Council of Teachers of Mathematics

Three Pittsburgh teachers were selected by PMC to attend the National Council of Teachers of Mathematics (NCTM) Annual Conference in Chicago, Illinois, April 6-9. Professional Enrichment Grants were used to help pay expenses. Teachers were selected based on their interest and on their ability to use and disseminate the information that would be presented. Teachers who attended the conference were asked to write an article for the newsletter and to share materials with colleagues.

Newsletter

In fall, 1987, the first issue of *GRAPHiti*, a newsletter for secondary mathematics teachers, was published by the collaborative. The newsletter, which is issued in the fall and spring, is a vehicle for publicizing and promoting collaborative events. Ms. Barbara Bridge, the collaborative's assistant coordinator, and Mr. Howard Bower, the district's mathematics supervisor, are the editors. The first issue of *GRAPHiti* contained articles on personnel changes, including teacher transfers and new positions; honors given to teachers; computer instruction; professional enrichment grants; and the summer conferences held at Exeter and in Durham, North Carolina. The second issue, which was published in April, 1988, included articles on professional enrichment grants, the annual Urban Mathematics Collaborative meeting in New Orleans, employability skills, and information about teachers' activities.

E. Observations

Project Management

The management structure of the Pittsburgh Mathematics Collaborative has remained the same over the past two years. The Executive Committee ("First Tuesday Committee"), under the direction of Dr. Salmon-Cox, continues to be the collaborative's central agent for strategic planning. Early concerns about the lack of teacher representation on the committee and whether its very structure restricted teacher input into the planning process were allayed this year as teachers became involved through the Department Chairs' Group and the two teacher committees, the Computer Training Group and The General Mathematics Redesign Group. These teacher groups are maturing and developing a greater sense of purpose and direction.

It is the role of the teacher groups to channel information between the collaborative administration and the teachers in the district. Drs. Salmon-Cox and Briars serve as the links between the teacher groups and the Executive Committee. Because they both are readily accessible to the teachers, at meetings and at other times, teachers feel that they have input into the collaborative. Teachers also view the roles of Dr. Salmon-Cox and Dr. Briars as helpful to them; for example, teachers have expressed appreciation for the work Dr. Salmon-Cox does with the Department Chairs' Group. One chair credited her with being able to circumvent channels to facilitate accomplishment of the group's goals. Dr. Briars provides access to the central administration and is able to make things happen.

The collaborative's centralized management structure seems to be working well. This success may be attributed to the group's regular meetings that allow necessary planning, the support and input of several teacher groups that have raised specific issues, and the access that teachers have to the members of the Executive Committee. One problem that has resulted from this structure, however, is that teachers do not always understand the rationale for decisions. This may suggest that communication from the Executive Committee to the teachers may need to become more clear or explicit. For example, the Executive Committee decided this year to eliminate site visits to business and industries from the collaborative's agenda; since all teachers had participated in at least one site visit the previous year, the Committee felt that something different might be of more value and interest. At least one teacher, however, viewed the lack of site visits as a reduction in the collaborative's activities, and as an indication that the collaborative was on the decline.

In 1986-87, Dr. Salmon-Cox came to believe that collaborative activities, such as Professional Educational Grants, were becoming routinized, that her position as project coordinator should be phased out, and that the collaborative should be merged into the school district. During the past year, however, a distinct change has occurred in how the collaborative and related activities are being viewed. An outgrowth of the collaborative has been the networking among and support to projects that cover the K-12 mathematics curriculum. During the 1987 school year, the district, with the help of Dr. Salmon-Cox, has attended to the teaching of mathematics in middle and elementary schools. Drs. Salmon-Cox and Briars wrote an NSF grant, which was funded, to work with middle school teachers. In light of this new grant and expanded responsibilities, budget management and strategic planning and coordination have emerged as administrative priorities. While the position of coordinator remains important to the collaborative, it appears that the role may adopt a different orientation; one of the unique features of the Pittsburgh Mathematics Collaborative has been the involvement of the director in the day-to-day operations, and this may have to change as the project expands.

Another change in strategy has involved the increased role of teacher task groups; two new groups were formed during the 1987-88 school year. These, and the Department Chairs' Group, have worked well to involve teachers, to plan specific actions, and to affect the curriculum. For 1988-89, the assistant coordinator's title will be changed to Collaborative Liaison. Instead of soliciting teachers' input or help on an as-needed basis, Ms. Bridge now will be advised by a group of teachers. What seems to be lacking in this relationship, however, is input from members of the business, industry, and higher education communities.

In the Pittsburgh model that is evolving, it appears that critical decisions about the collaborative still will be made by a small core group. However, strategies are being developed to ensure that this group will be alert and sensitive to input and recommendations from a number of teacher task groups. The task groups also will have direct input into the district's mathematics program. While the collaborative has been a key force behind the development of the task groups, it is anticipated that the groups will find their natural place within the district's overall program. In addition, efforts are being made to form new projects that will create links among secondary mathematics teachers, teachers from grades K-8, and representatives from higher education.

Factors that contribute to the success of the Pittsburgh model are the manageable size of the district, the close interaction between the director of mathematics and the collaborative coordinator, a high degree of school district involvement, and the high quality of the people who play central roles in management and in teaching.

Collaboration

The form of collaboration most evident in Pittsburgh is the interaction among teachers themselves. This new collegiality, which emerges in committee meetings and at various collaborative events, seems to be one reason why the mathematics teachers, in particular, have been able to use their weekly TIP time effectively. One department chair reported that this time was being used more effectively by the mathematics teachers than by those in other content areas, as it appears the mathematics teachers have more clear and well-articulated goals.

The rapport among teachers in the Pittsburgh high schools is clearly evident to even casual observers. Teachers within the schools seem to cooperate and enjoy one another's company. They also seem comfortable when a mathematics supervisor observes their classes and performs the required evaluation procedure.

As in other collaboratives, some teachers have expanded their collegial relationships to include teachers at other collaborative sites. Through participation in institutes and workshops at Phillips Exeter and the North Carolina School of Science and Mathematics, teachers in Pittsburgh have acquired what some have labeled "national colleagues." Some teachers' eagerness to attend national professional meetings, such as the annual NCTM conference, can be attributed in part to their desire to renew the friendships that they have developed. A teacher of nine years who attended her first NCTM annual meeting last year developed a stronger desire to attend this year because of the opportunity to see her "national" colleagues, an interest developed through collaborative activities and enhanced because the collaborative was willing to assume some of her expenses.

This year the collaborative expanded its efforts to build relationships with representatives of higher education. Two professors from the University of Pittsburgh worked closely with Executive Committee members and also made a presentation to collaborative teachers. Plans are being made to increase these professors' direct involvement with teachers, perhaps through a research project on conjecturing. Although the membership of the collaborative's Steering Committee has always included people from higher education, this was the first year that plans and activities took place that may lead to long-term relationships.

Conversely, a strategy for building a strong relationship between teachers and representatives of business and industry has not emerged. The collaborative's current organizational structure does not actively pursue or foster ties to the business community. The Executive Committee is comprised of either collaborative staff or administrators of supporting agencies. While the members of the business and industrial communities serve on the Steering Committee, this group acts primarily as a sounding board for progress being made and does not initiate a significant level of exchange with representatives of the business and education communities. Although site visits stimulated the exchange of ideas among the small number of teachers and business persons involved in the planning effort, no long-term working relationships between teachers and business representatives resulted.

The math-intensive program piloted at one school this year may offer an avenue through which business and industry may interact with teachers. Even so, the tutoring program provided business people the opportunity to serve as a resource to students rather than to teachers; it was more of a school-business partnership program with mathematics as the general area of interest. There was very little of the exchange between teachers and those in business and industry that has been envisioned in the collaborative's proposals. Steps intended to foster a more positive and fruitful relationship between the collaborative and the business sector include changing the assistant coordinator position to that of Collaborative Liaison and forming a Teacher Advisory Board.

The collaborative experience is beginning to affect the professional lives of the key people involved in its management. Dr. Salmon-Cox was approached by the director of LRDC to participate in writing a proposal regarding the establishment of a mini-center. She also addressed the concept of a collaborative for a symposium sponsored by the Pennsylvania Council on International Education. Dr. Briars uses a collaborative approach to staff development, encouraging teacher participation in curriculum decisions.

Professionalism

Pittsburgh mathematics teachers speak favorably about their work and the conditions under which they are working. Compared with teachers in other urban areas, Pittsburgh teachers are well paid. They experience a sense of job security that does not exist in many of the industries in the surrounding area. As noted by a teacher with 25 years experience, "The status of teachers today is higher than when steel was big." Many teachers, when asked, reported that they like teaching and would not consider doing anything else. This is evidenced by the small amount of turnover in mathematics teaching positions in the district, a condition that has resulted in a very experienced teaching staff.

Mathematics teachers appear, in general, to cooperate with the district. The PRISM model of teaching is very evident in the classroom; the lesson objective is written on the board and the prescribed lesson-development sequences are followed. Teachers seemed to have adjusted to this approach as well as to the classroom observations that are part of the PRISM program. One reason for this general acceptance may be that the district was careful to devote adequate time to teacher training in implementing the PRISM model.

Although teachers say they like teaching in general and feel that the school district is cooperative, some do not feel entirely understood or appreciated by the community, nor would they recommend teaching as a profession. As one teacher said, "Schools and teachers are expected to do more than what they are prepared to do. This is because teachers work with students with real problems. There are those in the community who are not sensitive to teaching and feel that teachers are part of the problem." This teacher noted that she would not recommend to her students that they choose teaching as a profession.

Since there are so many factors affecting the teaching of mathematics in Pittsburgh, it is difficult to attribute specific changes to the collaborative. However, interviews with teachers, as well as their own discussions, suggest that the collaborative has added a new dimension to the teachers' professional lives. Collaborative support has encouraged more Pittsburgh teachers to attend professional meetings and to become involved in professional organizations. One teacher said that she went to the state mathematics teachers' meeting for the first time in her nine years of teaching because of the opportunity provided by the collaborative. Another teacher said that he has renewed his interest, which had waned over the years, in a state mathematics teachers' organization. Another teacher applied and received a grant to attend the International Congress for Mathematics Education that was held in Budapest in August, 1988. A fourth teacher commented that the collaborative treats teachers like professionals.

A new vitality also is emerging among mathematics teachers in Pittsburgh. For the first time, a mathematics department chair was asked by a group of elementary school parents to make a presentation to their PTA about the high school mathematics program. Those on the computer committee continually exchange ideas and talk with one another. These activities, in conjunction with more teachers' increased interest in professional organizations, suggest that a professional renaissance is taking place among Pittsburgh mathematics teachers.

Mathematics Focus

The mathematics focus of the collaborative appears to be directed toward curriculum reform. During 1987-88, the draft of the NCTM *Curriculum and Evaluation Standards* was a major topic of discussion. The *Standards* were presented at an in-service in October, and they also played a key role in the decision by the General Mathematics Redesign Group to try a variety of materials rather than select a single textbook. This group also reflected the *Standards*' emphases on problem solving, data analyses, communication, algebra, and geometry in the general mathematics course. The *Standards* was included as a main agenda item for the Steering Committee meeting. In the previous year, Professor Zal Usiskin made a presentation on the University of Chicago School Mathematics Project. In February, Ed Silver talked about the "Emerging Vision of Mathematics Education." All of these activities are directed toward curriculum reform.

In addition to collaborative efforts, the district mathematics director and supervisors are working to activate change. There is a shared realization that affecting the existing curriculum will take several years, but the process has been initiated and the collaborative's activities and resources have been brought to bear to help advance change. Collaborative participants also understand that if change is to occur, teachers must play an active role. Sensitivity to this issue is evident through teachers' involvement in on-going task groups.

The collaborative has developed a strong interest in fostering the use of modern technology in the classroom. In 1987, the collaborative helped make it possible for all mathematics teachers to have access to a classroom set of calculators. This year, the district provided funds for every mathematics department to have a computer and a large screen monitor. The collaborative also has helped to support the Computer Training Group as well as teachers' attendance at other meetings, such as the NCSSM Institute, to learn more about using computers in the teaching of mathematics.

The collaborative has played a major role in instigating change in the mathematics curriculum in Pittsburgh, and an increased awareness of the issues among teachers has been achieved. But departures from more traditional approaches in teaching have not been readily apparent in classrooms. In observations of six different teachers in six different classrooms, it became clear that teachers' primary mode of instruction remains lecturing to students. In some classes, students did homework problems at the board. There was very little teacher-student interaction, except in a few instances in which the teacher engaged students by asking specific questions. No small-group work was observed nor was there evidence of a problem-solving approach to teaching. In the future it will be important to document how the enthusiasm of teachers and their exposure to new ideas translate into the actual teaching of mathematics. What is important to note at this time is that the concepts of reform have been introduced and that a positive climate in the Pittsburgh Schools towards mathematics education has evolved. The collaborative certainly appears to be a key factor in both of these developments.

F. Next Steps

Over the next three years the Pittsburgh Mathematics Collaborative will experience a transition period as it becomes institutionalized and establishes the requisite mechanisms it will need to become permanent. Tasks groups will be established, but each will take on a life of its own within the structure of the school district. Teachers will perform a follow-up on the impact of computers in mathematics instruction, and they will conduct a field experiment using experimental materials from the College Board and Educational Testing Service (ETS). The collaborative will make an effort to become a site for pilot-testing model equity programs to help address the achievement gap between black and white students. A teacher group will be established to advise the Collaborative Liaison on events and activities to be held in cooperation with business and industry. Finally, the working relationships that have been formed with those in higher education will be fostered and strengthened through work on mutually relevant activities.

SUMMARY REPORT:
ST. LOUIS URBAN MATHEMATICS COLLABORATIVE

by the

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the St. Louis Urban Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the St. Louis Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM conference in Chicago in April, 1988; survey data provided by teachers; and two site visits by the staff of the Documentation Project.

ST. LOUIS URBAN MATHEMATICS COLLABORATIVE

A. Purpose

As stated in the funding proposal to the Ford Foundation, which was produced with the active involvement of a group of secondary mathematics teachers, the goal of the St. Louis Urban Mathematics Collaborative is to foster a spirit of collaboration among St. Louis Public Schools mathematics teachers, university mathematics professors, and mathematicians from local business and industry. The collaborative's primary goals, as stated in the funding proposal, are:

1. Teachers will explore potential resources among businesses, industries, and universities to discover how these resources may assist them in their own professional growth and in their classroom instruction.

2. Teachers will develop, assist in developing, and implement staff training programs for themselves and for their peers.

3. Teachers will assist in improving communications and exchanges of information among all mathematics teachers within each school and across schools.

4. Teachers will promote the recognition of accomplishments and quality performance among all mathematics teachers and students.

B. Context

The city of St. Louis has a population of approximately 450,000; the population of the entire metropolitan area exceeds 2 million. Dr. Jerome B. Jones is the Superintendent of the St. Louis Public Schools, a position he has held for five years. Dr. Jones is assisted by Deputy Superintendent Cozy W. Marks Jr., and five associate superintendents. There are four assistant superintendents: one for the high schools, one for the middle schools, one for the elementary schools, and one who coordinates the effective and efficient schools programs. The St. Louis Board of Education is comprised of twelve members. In June, 1988, Dr. Joyce M. Thomas was elected to a one-year term as president of the Board.

The district's 1987-88 budget was $235 million, with a per-student expenditure of about $5,100. Approximately 40 percent of the district's budget is paid by local revenue, 48 percent by state funds, 10 percent by federal sources and 2 percent by the county. In June, the voters passed a school tax rollback of 51 cents for 1988-89, and a 52 cent tax increase. As a result of these two measures, $22 million will be available this year for building maintenance and repair, increased salaries, and improved curriculum.

In September, 1987, student enrollment in the St. Louis schools totalled 46,146, including 11,297 in the city's high schools. This represents a decline of about 4 percent from the previous year. Seventy-seven percent of the total student population in the district is black, 21 percent is white, 1 percent is Asian and less than 1 percent come from other minority groups. Fifty-one percent of students are males and 49 percent are females. Ninety-five percent of St. Louis Public Schools students take part in federally funded lunch programs.

The district has eight regular high schools, six secondary magnet schools, and one vocational/technical school. In addition, there are nine secondary alternative/specialty programs, some of which are housed in regular or magnet high schools. Student enrollment at each of the regular high schools ranges from 1,504 to 536, with an average enrollment of 980 students. Seventy-six percent of the high school students in the district are black, 21 percent are white, 2 percent are Asian and less than one percent originate from other ethnic groups.

The St. Louis Public Schools employ 104 high school mathematics teachers. Fifty-seven percent are black, 41 percent are white and 2 percent represent other minorities.

Beginning with the 1985-86 freshman class, students are required to have three years of mathematics in order to graduate.

The St. Louis School District has been operating under court-ordered desegregation since 1980. Part of this order is a voluntary city-county desegregation program under which any student from an all-black school in the city may transfer to a county district school in which black enrollment is under 25 percent. County districts are paid incentive funds to accept city students. Approximately 11,000 city students attended county schools during the 1987-88 school year.

The district judge has issued an order that sixteen schools in the city must close over the next three years because the buildings are unsafe. The students will be absorbed by other neighborhood or magnet schools.

In 1986 the St. Louis Board of Education voted to use student scores on the California Achievement Test (CAT) as one criterion for teacher evaluation. A teacher cannot receive a satisfactory rating unless at least half of his or her class scored at or above the national norms on the CAT or show a year's worth of progress since the previous year's testing. One goal of this practice--improved test scores--has been achieved: a majority of students in all grades scored at or above the national average for the first time since 1981. Despite this, the policy has not been well received by some teachers. In March, 1988, the district and the teachers reached an out-of-court settlement over a federal lawsuit filed by the St. Louis Teachers Union. Both sides agreed to phase out the use of the CAT scores in teacher evaluations and to establish a three-member committee, two appointed by the City Board and one by the union, to review all situations in which a teacher was marked unsatisfactory because of CAT scores. The current form of the CAT will be replaced and, in addition, criteria-referenced tests will be developed through funding by the City Board of Education. It was undecided as to what extent student scores on the new test will be used in evaluating teachers.

Teachers have the opportunity to earn advanced degrees through a variety of programs, including the Parson Blewett Foundation, which honors a former school superintendent. Textbook publishers have helped to sponsor in-service activities for mathematics teachers and Title II funds, which are available for mathematics and science activities, have been used to sponsor collaborative teachers' attendance at seminars held after normal school hours.

C. Development of the Collaborative

The collaborative is funded through the Mathematics and Science Education Center (MSEC). The Center, which operates under the auspices of the Network for Education Development, is primarily responsible for raising funds for education from businesses in the St. Louis area.

The director of the Mathematics and Science Education Center is Dr. Paul Markovits. He is guided by a Board of Directors and two advisory committees, one for mathematics and one for science. These councils are responsible for planning the

Center's activities and programs in their respective content areas. The Mathematics Program Committee plans its activities in conjunction with the Mathematics Educators of Greater St. Louis, a mathematics teachers' organization. During the year, this group sponsored a series of seminars during school hours, in the evenings, and on Saturdays. Topics included Problem Solving, Mathematical Modeling, Estimation and Mental Arithmetic, Probability and Statistics, and The Use of Microcomputers in Mathematics. The Center serves teachers in both city and county schools.

Judy Morton has served as collaborative director since the project's inception in April, 1986. During 1987-88, she was assisted by Collaborative Coordinator Karen McCarthy, a law school student who assumed the part-time coordinator position in October, 1987. Ms. McCarthy, who is experienced in the administration of nonprofit organizations and foundations, assumed responsibility for similar tasks with the collaborative. On April 1, Donald Thompson assumed the position of on-site observer that had been held by James Richmond. Mr. Thompson has been a mathematics teacher at Soldan High School for 25 years.

The MSEC and the collaborative, both established early in 1986, have worked during the past two years to develop their own programs and their relationship with each other. In general, the collaborative has operated independently of MSEC, but the two programs are unofficially linked in a variety of ways. While the Center's mathematics committee is not officially associated with the collaborative, one district mathematics supervisor is involved with both. The director of the collaborative periodically attends the mathematics committee's meetings, but is not an official member. And, because the Ford Foundation grant and the matching funds are administered through the Center, the collaborative's budget falls under the jurisdiction of MSEC. The collaborative director, however, has retained major control over how the funds are allocated. As long as there is money in the collaborative's budget for the activities that the Council decides upon, the money is spent. On only one occasion did the Center inform the collaborative that money was not in the budget for an activity. This budgetary arrangement has freed the collaborative director from the responsibility of fund raising.

The Collaborative Council

The Collaborative Council continued to be the collaborative's major planning and decision-making group. During the 1987-88 school year, the Council was expanded to include a professor from the University of Missouri-St. Louis, and two representatives from business, in addition to the twelve teacher members. Other Council members include Judy Morton, collaborative director; Karen McCarthy, collaborative coordinator; the three mathematics supervisors for the St. Louis Public Schools; Wayne Walker, director of the Partnership Program; and a representative of the St. Louis Public Schools Division of Technology Development.

Teachers serving on the Council have the opportunity to resign at the end of each school year. Other teachers who have expressed an interest are then asked to join; thus far, all teachers who have expressed interest have been invited to serve. The Council meets once on the second Wednesday of each month at universities, high schools, district administrative offices, and businesses. In June, the Council published a directory listing the high school mathematics teachers in the district, along with their home schools and their special interests and hobbies. A copy was sent to each secondary mathematics teacher. The minutes of each Council meeting are sent to each of the mathematics teachers in the district.

Council Subcommittees

Through discussion and consensus, the Council makes program decisions for the collaborative; specific tasks for particular activities are assigned to subcommittees. Members of the subcommittees responsible for planning the Mathematics Contest and the Mathematics Fair continued their work during the summer, for which they received stipends provided by the collaborative. In fall, 1987, a third subcommittee was established to investigate ways that teachers could become more involved with business. This group was composed initially of four members: a representative of business, the director of the Partnership Program, the collaborative coordinator and a teacher. The group planned a mathematics computer software seminar and four site visits in June. A fourth subcommittee, established to develop the criteria by which the collaborative could evaluate teachers' requests for funds to attend seminars and conferences, reported to the Council at its March meeting. In May, the Council identified a fifth subcommittee to develop a plan for collaborative efforts to improve the curriculum during the 1988-89 school year. In June, a sixth subcommittee was formed to determine procedures for selecting the Council's chairpersons and co-chairs; until the subcommittee's recommendations are adopted, Anita Madsen will serve as chair. Late in the school year, a seventh subcommittee was established to investigate ways that the collaborative can survive after the Ford Foundation's funding is terminated.

Persuading local business people to become involved with the collaborative has been a slow, sometimes difficult process. Initially, Wayne Walker and a teacher invited several business people to serve on the Council, but they refused. After being contacted by the mathematics contest committee, CNA Insurance agreed to provide prizes; the company consented to participate because of its interest in public education and its tradition of helping schools in other cities. After this initial contact, the collaborative invited William Carroll, a manager for CNA, to join the council. He attended his first meeting in December, 1987, and has attended nearly all the meetings since then.

During the 1987-88 school year, the MSEC began to feel a need to have a mathematics specialist in a leadership role. Since Center Director Paul Markovits has a science background, it was felt that science was adequately covered. The Center's Board of Directors decided to hire a full-time mathematics person who would direct the collaborative half time and work for the Center half time. The position was announced in April, and Helene Sherman, a mathematics education instructor at the University of Missouri-St. Louis, was hired in July. Judy Morton will continue to be associated with the Center to help raise funds and to foster developing relationships between teachers and the local business community.

D. Project Activities

During the 1987-88 school year, the St. Louis Mathematics Collaborative sponsored a wide variety of activities for high school mathematics teachers in the St. Louis Public Schools. In addition, the collaborative promoted teacher participation in a variety of activities that were sponsored by other organizations but were related to fulfilling collaborative goals.

Local Workshops, Seminars and Symposia

Workshop on the Challenge of the Unknown

The collaborative sponsored a workshop on the Challenge of the Unknown Film Series on Friday and Saturday, February 19-20, at the University of Missouri. Dr. Gerald Kulm, project director at the American Association for the Advancement of Science in Washington, D.C., led the workshop, which was designed to improve teachers' problem-solving skills and to enhance creative approaches to teaching mathematics. Workshop activities emphasized direct experience to encourage teachers to develop their own plans for adapting and implementing the Challenge of the Unknown materials in their classrooms. All high school mathematics teachers from the St. Louis Public Schools were invited to attend free of charge. The collaborative also provided lunch on Saturday for all participants.

Ten teachers and two administrators, as well as two members of the collaborative staff, attended the workshop. The Collaborative Council reported that those who participated gained many valuable ideas about how to engage students in thinking about mathematics in interesting ways. All teachers who completed the workshop received a teacher's guide and a set of supplementary teaching materials.

Visit with Uri Treisman

On March 3-5, Dr. Uri Treisman, a professor of mathematics at the University of California-Berkeley who also teaches several high school mathematics classes, visited with collaborative teachers. He spent time in several teachers' classrooms on Thursday and Friday, March 3-4, demonstrating methods of helping students work together successfully. On Saturday, Dr. Treisman led a seminar, "Structuring Effective Study Settings for Minority Students" at the St. Louis University Law School. He talked about organizing student groups, fostering productive group interactions and problem solving, and developing intervention strategies to assist students who are not performing well.

The Council reported that the twenty teachers who participated found Dr. Treisman's visit inspiring and valuable. The collaborative discussed plans to invite Dr. Treisman to return next year for an activity that will involve more teachers.

Topics In Secondary Mathematics: Using the Computer to Assist in Teaching Mathematics

On June 15-21, 1988, the collaborative co-sponsored a one-week workshop with the St. Louis Public Schools and the North Carolina School of Science and Mathematics (NCSSM) to present the Introduction to College Mathematics materials produced by NCSSM.

The workshop, which was held at the University of Missouri- St. Louis, was taught by four secondary school teachers, including two from the St. Louis Public Schools. All

St. Louis city and county teachers of grades 7-12 were invited to attend. There was no registration fee and participants received materials and software programs.

The workshop covered various mathematical topics that use the computer as an aid to problem solving, including geometric probability, data analysis, matrices, and functions. Approaches for incorporating these topics into the entire secondary mathematics curriculum were explored and discussed.

Only ten teachers and two administrators participated in the workshop. The poor attendance was attributed to the fact that the school year had just ended and it was not a convenient time for teachers to participate in a five-day workshop. Teachers who did attend, however, felt that the conference was very worthwhile. One teacher said, "I was impressed by the North Carolina project. I learned many new ways for using math modeling; I have always been very interested in this subject. The workshop was very well planned and presented. I am very glad I attended." Another added, "I thought all teachers really enjoyed the workshop. It was a good workshop that showed many new uses of the computer in the classroom. If we can get the teachers to use the material; of course the first thing we must do is get our computers up to 512K. Most schools only have 256K." A third teacher said, "I was introduced to some very good computer software. I not only learned about using the computer, but was able to review many concepts in functions, statistics, probability, etc. that I had not studied in many years. The presenters did a very good job. I plan to use the material I received."

Dinner Symposium

The Changing Mathematics Classroom: The Influence of New Technologies

On May 9, the St. Louis collaborative and IBM co-sponsored a dinner symposium, "The Changing Mathematics Classroom: The Influence of New Technologies." Dr. Irwin Hoffman of George Washington High School in Denver, Colorado, discussed how technologies are changing mathematics at the secondary school level and how teachers can use the new technologies to their advantage in mathematics classrooms. Dr. Hoffman also presented, "The Math Toolkit," which is a software package for graphics, and demonstrated a piece of hardware that enables a teacher to use an overhead projector to project a computer screen onto a wall. A complimentary dinner followed the presentation.

Approximately sixty-five teachers and school administrators attended the dinner symposium, including Dr. Robert DeBlauw, the Director of Technology for the St. Louis Public Schools, who said he would investigate the possibility of purchasing the software for district use. One teacher commented, "The symposium was excellent. Every teacher could use this valuable tool in the classroom. Dr. Hoffman gave an excellent presentation. I would like to see him back." Another added, "Excellent. It is amazing what this piece of software can do. I can see students spending hours solving and graphing equations. I could spend hours playing with this machine. Would it not be nice if the Board could find money to place one of these in each classroom." A third said, "I would like to have more symposia. The presenter was great. He seemed to have really enjoyed what he was doing."

Locally Sponsored Seminars

After reviewing materials from a variety of seminars and workshops to be offered in the St. Louis area during 1987-88, the collaborative's Conference and Seminar Committee identified several it considered most relevant to the collaborative's goals and agreed to pay registration fees for collaborative teachers. The committee also established criteria by which teachers who applied for collaborative support to attend these events would be selected. Attendance at five seminars was approved.

Estimation and Mental Computation. This seminar was held on January 28, 1988. The collaborative agreed to pay the registration fee for three teachers to attend.

Teaching With the Geometric Supposer. The collaborative agreed to pay the registration fee for up to five teachers to attend this seminar, which was held February 3. The seminar, led by Tammy Popp, focused on teaching geometry using the computer. Students used the computer to draw pictures which, in turn, helped them to identify proportions. Five collaborative teachers attended.

Midwest Education and Technology Conference. Initially, the collaborative offered to pay expenses for three teachers to attend this two-day conference, which was held February 4-5. Approximately ten teachers actually received funding to attend.

The Way to the Math Solution. This seminar, held February 24 for mathematics teachers of grades 9-12, focused on how to make problem solving an integral part of high school mathematics courses. Marilyn Burns, author of several mathematics activity books and the originator of the "Math Solution" workshops, and Nicholas Branca, a mathematics education professor from San Diego State University, made the presentations. Participants learned how to use manipulatives, such as geoboards, to teach mathematics concepts. The collaborative paid the registration fees for five teachers.

Statistical Conference. The Statistical Conference was held February 25 at the Network. The seminar focused on a series of experiments designed to show teachers how to set up hypothesis testing and confidence intervals, including computer applications. The collaborative had offered to pay the registration fee for up to five teachers to participate in the seminar. Two collaborative teachers attended.

National Conferences

Annual Meeting of the National Council of Teachers of Mathematics

The collaborative offered to sponsor seven teachers to attend the annual meeting of the National Council of Teachers of Mathematics in Chicago, Illinois, April 6-9, 1988. Each teacher received up to $235 to cover registration fees and hotel expenses. All collaborative teachers were encouraged to complete an application form.

Six teachers applied and attended the conference. One commented, "I was very glad to have an opportunity to attend the national convention. I would not have been able to attend without help from the math collaborative. I gathered many new teaching ideas from the convention." Another reported, "I am a computer teacher. . . . I attended two good workshops on uses of the computer. I was especially interested in a new book on PASCAL. The book companies agreed to send me books. I would like to see more group discussions on critical problems in math." A third teacher said, "The convention was great. Chicago is a great place to visit. Many good workshops and sessions. I was able to meet and talk with people from all over the United States. I gathered many new and exciting ways to approach mathematics. I enjoyed talking with some of the authors and representatives from the book companies. The collaborative should try to send more teachers to the convention in the future."

The on-site observer commented, "I attend the conference each year. I find it very valuable in keeping up with modern trends in math. This is a good use of collaborative money."

Site Visits to Businesses

In June, 1988, the collaborative repeated its successful summer site-visit program, which enables teachers to spend a full day at an area business to observe how mathematics is applied. Three visits were scheduled for June, but only the visit to the General American Life Insurance Co. on June 29 materialized due to poor teacher response. There was space for five teachers to make each visit, but only three teachers applied. Participants were asked to write a brief report of their visit, including a description of the mathematics applications, the requirements for an entry level position and the basic skills needed.

In the morning, the three teachers met with several managers and representatives from the personnel department to discuss the company and its entry-level requirements. General America's Life Insurance Company provided lunch and business associates were invited to eat with the teachers. In the afternoon, each teacher accompanied a business representative to observe the use of mathematics in the workplace. One teacher said, "The visit was very educational. The morning session where several actuaries discussed their job in several types of insurance showed many uses of mathematics. During the afternoon, I observed my shadow teaching summer school workers how to find premiums and compare various types of insurance. This gave me some ideas I could use in my classroom during the next school year. It is too bad that more teachers didn't sign up for these visits." Another added, "This was my first visit to a business. This was also the first time the person who guided me had visited with a teacher. I did find the reading of graphs to be something I could use in the classroom." The third teacher said, "I enjoyed the day. We were treated very well. I really felt welcomed. I thought the questions and answers between company representatives and teachers were very educational. . . . Everyone thought the event was a wonderful idea."

Teacher Internship Program

The McDonnell Douglas Corporation and the Mathematics and Science Education Center piloted a summer internship program for teachers beginning in June, 1988. The program was designed to enhance teachers' understandings of the application of science, mathematics and computer science in the marketplace. Five seven-week positions were available at a salary of $500 per week. Mathematics and science teachers from the region, not just the city, were eligible to apply and seventy-five applications were received. Only two teachers from the St. Louis Public Schools participated in the program, one chemistry teacher and one teacher who was subsequently hired by the school district as a biology teacher.

The internship involved two components: Teachers were expected to work full-time as a McDonnell Douglas employee, and then to translate what they learned into the development of curricular materials for classroom use. The curricular materials were to be developed during the internship and implemented during the following school year. School district content supervisors will be asked to work with the teacher interns to coordinate the newly generated materials with established curricula.

The collaborative encouraged teachers to participate and offered to assist them to complete the application. One collaborative teacher did submit an application.

Mathematics Fair

The collaborative sponsored its first Mathematics Fair, March 20-23, 1988, at the Division of Curriculum Services, St. Louis Public Schools. The Fair, which is slated to become an annual event, exhibited projects of St. Louis Public Schools secondary mathematics students to the public. The 110 projects were on display for three school days, during which a number of elementary, middle, and high school mathematics classes visited the Fair. An awards ceremony was held during the event's final evening. Approximately 120 students applied to participate. Some of the best projects were entered in the State Science Fair. As a result, the highest number of projects in recent history from the St. Louis Public Schools were awarded prizes at the State Science Fair.

The seven teachers who planned and organized the Fair received a stipend of $250 each from the collaborative.

Secondary Mathematics Contest

On April 23, the first St. Louis Public Schools Math Contest was held at the Academy of Math and Science. The contest, which was co-sponsored by the collaborative and four area businesses, was designed to encourage student competition and the study of advanced math. Each high school in the St. Louis Public Schools was asked to enter either one team consisting of eight members (two from each grade) that would compete for both team and individual awards, or up to eight students from any grade level who would compete for individual awards only. Each participating school was required to designate a faculty sponsor. In total, 187 teachers, administrators, business representatives, students and parents attended. The contest is expected to become an annual event.

Reaction to the contest was extremely positive. One teacher commented, "The contest was well planned. I was very glad to see so many administrators out. . . . This was a good experience for our students. They really enjoyed the whole day. We need more of this type of activity. This shows what teachers, supervisors and administrators can do when they work together." Another observed, "The math contest was an excellent idea that should be continued in the future. Everything worked out real well. I thought the test was too hard. It sort of discouraged some of the students from the regular high schools." A third teacher said, "I was really happy to see so many students and especially teachers out on a Saturday morning. To give up time on Saturday shows a real liking for math. The contest went over very well, a good idea. The test had a wide range of good questions, but too much geometry. The event impressed Dr. Dix [the Associate Superintendent] and other school officials. I feel they will help to carry on the contest and Math Fair in the future."

A representative for IBM said, "IBM is proud to have helped sponsor this program. Math is so important and it is really a pleasure to see so many young people involved." Ms. Robin Boyce, Program Director of the radio station KMJM, who was the guest speaker, said, "I am proud of the St. Louis schools. I graduated from Soldan High. It was a joy to be able to speak today."

Social Gatherings

The collaborative sponsored three social events for mathematics teachers and administrators to provide them an opportunity to meet and network outside the work setting. The socials also served to attract teachers who had not previously participated in collaborative activities.

The Fall Social was held November 4 at the Forest Park Hotel. Forty-two teachers, eight administrators from the school district, and the collaborative director and coordinator attended the event.

The Winter Social was held January 25 after an in-service for secondary mathematics teachers at the Missouri Historical Society. Almost half of the 104 teachers who had attended the in-service attended the Winter Social. In addition, fifteen school district administrators attended. As a result of the social, several teachers from each high school volunteered to serve as contacts for future collaborative communications.

The Spring Social was held May 18 at the Missouri Botanical Garden. Thirty teachers and administrators attended. One teacher commented, "These socials are very educational. I have a chance to see and talk with teachers I do not see very often. This practice should be continued next year."

Teacher Directory

In the spring of 1988, the Mathematics Collaborative Council published a booklet listing the name, school, school phone and home address of all secondary mathematics teachers who elected to participate. Optional information included special areas of expertise, mathematics seminars or lectures presented (or prepared to present), home phone and favorite hobbies. The booklet was made available to all St. Louis Public School secondary mathematics teachers free of charge. The collaborative staff felt that publishing the teacher directory was an important step in facilitating networking across schools.

E. Observations

Project Management

The collaborative's management structure was adjusted during the 1987-88 school year to meet its changing administrative and leadership needs. These changes must be viewed in light of the circumstances under which the collaborative was established. The St. Louis Mathematics Collaborative and the MSEC came into existence almost simultaneously; as local educators worked in 1985-86 to organize the MSEC and to identify a director, the Ford Foundation was approaching the Danforth Foundation in St. Louis about forming a mathematics collaborative. Judy Morton served as interim director of the Center during its formative stages, until Paul Markovits was appointed in August, 1986. In December, 1986, at the first meeting of the Mathematics

Collaborative Council, Ms. Morton officially assumed the role of collaborative director. She continued to serve as a consultant to the Center.

During the 1986-87 school year, the collaborative and its Council, and the MSEC and its Board, operated rather independently. The director of the MSEC, assisted by a limited staff, directed his efforts at establishing the Center. There was some communication between the two organizations, however, since a mathematics supervisor from the St. Louis Public Schools sat on both the Council and the MSEC Program Committee, and the collaborative director attended MSEC Board meetings as an observer. Furthermore, the budget for the collaborative was administrated through the MSEC.

By the beginning of the 1987-88 school year, the MSEC Board and the Center's director felt that the Center staff should include a person with a strong orientation in mathematics education, a role they believed could be filled by the position of collaborative coordinator. The collaborative's director, however, felt that the coordinator should serve as an administrative assistant and hired a person with a background in foundation work.

In the middle of the 1987-88 school year, the MSEC Board decided to create a position for a full-time mathematics educator who would work half time for the Center, and half time as collaborative director. Helene Sherman was hired to begin work on July 1, 1988. Ms. Sherman will be responsible for management of the MSEC's mathematics programs, including those of the collaborative. Ms. Morton will continue to be associated with the collaborative, helping to raise funds and to provide opportunities for collaborative teachers to associate with area businesses.

It should be noted that the St. Louis Mathematics Collaborative is the only one of the eleven collaboratives that was established concurrently with its host agency. Given the newness of both agencies, it is not surprising that their management roles should need restructuring as the organizations evolved.

The strong independence of both the Center and the collaborative was a second factor that led to change and that may have caused some tension: The two organizations developed concurrently--but not in concert. The Center's mission dictates that it serve all districts in the St. Louis area, while the collaborative's focus is restricted to teachers in the city schools.

A final reason for the independent evolution of the two organizations was the lack of a policy board to coordinate MSEC and collaborative activities. The Council made program decisions for the collaborative, while the MSEC Board and its mathematics advisory committee developed programs for the Center--with limited coordination between the two.

Toward the end of 1987-88, as the collaborative management was experiencing transition, the Collaborative Council developed into an independent, productive group. A great deal of energy was expended by individual members and subgroups of the Council to plan, organize, and conduct activities. During the year, collaborative teachers initiated both a mathematics fair and a mathematics contest. Two socials were held and a dinner symposium was conducted. Planning, implementing and evaluating these activities transformed the Council into an effective, cohesive governing body.

Early in the 1987-88 school year, the Technical Assistance Project--supported by a November 1987 letter from Barbara Scott Nelson, the Ford Foundation project monitor--suggested that the collaborative form a board to include representatives from the different sectors--business, university, school district--that could set policy, help plan long-term strategy, and advise the collaborative director. In her letter, Dr. Nelson indicated that virtually all of the other collaboratives have such an advisory board to help with strategic planning and networking among various key groups. In response to Dr. Nelson's suggestion, the collaborative director initiated efforts to establish an advisory group but given the impending change in the collaborative leadership, the policy board has not yet been formed.

Collaboration

The collaborative experience has generated a new kind of interaction and collegiality among teachers. In response to questions about the most significant changes that can be attributed to the collaborative, a department head who has been a frequent participant in the collaborative credited the project with the stronger relationships he has developed with the mathematics teachers in his department. He said, "Networking--I now know 20 percent of my math teachers personally." Another teacher said, "Now I am more informed about other math departments and the city universities." The level of interaction has exceeded simple acquaintanceships and, for some, has evolved into a sense of membership in a clearly defined professional group. "As a whole it [the collaborative] has made us feel that we are an organized group with a common interest of educating the community, as well as the student," said one teacher. Another reports, "Staff morale has improved. A network of mathematics teachers is solidifying."

The collaborative's success in fostering collegiality can be attributed to teachers' involvement in the project since its inception. Collaborative teachers who serve on the Council have come to appreciate the value of cooperative effort; they understand that they are engaged in making decisions and planning activities that benefit their colleagues. The creation of subcommittees to accomplish specific tasks has worked well to broaden the number of teacher participants. In addition, all collaborative teachers receive the minutes of the Council's meetings, a practice which keeps them informed about what is happening. A teacher who occasionally participates in collaborative activities credited the collaborative with "keeping [me] updated on the latest math developments and knowing a support organization is available."

The activities of the Council's working groups also have helped to involve business representatives in the collaborative's activities. In their search for contest prizes, for example, subcommittee members identified an insurance company executive who was willing to attend Council meetings. This individual's involvement seems to have been influenced by a number of factors: CNA has a tradition of working with school districts; the St. Louis School District has a contract with CNA; and this particular individual has a personal interest in education. Despite these incentives, this business executive may have been reluctant to respond positively to a general request for assistance; having a specific task in mind, such as providing prizes for the mathematics contest, helps to provide a focus and an entry to the organization. This approach was far more successful than simply asking businesses if a person from their organization would be interested in serving on the Council. Prior to the CNA contact, two members of the Collaborative Council had asked five businesses whether someone would serve on the Council. All five rejected the offer.

Business has also been cooperative in providing speakers, such as the IBM employee who spoke at the dinner symposium, and in sponsoring site visits. Similarly, university representatives have served on the Council, spoken at events, and provided housing for the collaborative office. The collaborative, initially established by teachers for teachers, is beginning to expand to include greater participation by those from business and higher education. In summary, collaboration among teachers has increased significantly this year. By expanding Council membership and soliciting outside help in activities, collaboration among teachers, and between teachers and representatives of business and universities is beginning.

Professionalism

In the UMC project's 1986-87 annual report, the opportunities for professional growth in St. Louis were described as limited. Student test scores were being used as a criteria for teacher evaluation, incentives to engage in professional opportunities were scarce, and funding to attend professional meetings was largely unavailable. Some teachers reported low morale among their colleagues. During the 1987-88 school year, changes were made to improve the professional environment of St. Louis mathematics teachers. The issue of using student test scores in evaluating teachers was raised by the teachers' union in its negotiations with the Board of Education. The collaborative helped mathematics teachers participate in professional activities by publicizing events and by providing financial support. In addition, the collaborative has conducted its own seminars and programs. One teacher, in describing significant changes attributed to the collaborative, said, "It has helped teachers who normally do not have support (especially financial support) from our Board of Education to attend seminars, and conferences which help teachers grow and develop professionally. This is a requirement for the teaching profession." Another said, "The collaborative has made me more aware of what's available in the math area. I keep abreast of more organizations and have been involved in more activities."

The networking among teachers also has fostered in some teachers a renewed interest in their profession. One teacher commented on a change of attitude towards working conditions: "I spend far more time outside class in cooperative planning with my department head and colleagues than I did previously. The St. Louis Board of Education is getting almost double with zero dollars input from them!" Even the teachers who are only occasionally involved in collaborative activities are responding to its influence. One such teacher explained, ". . . the activities are a frequent reminder of the need for continuing professional involvement and growth by the dedicated teacher."

Teachers in St. Louis are beginning to find that their participation in the collaborative is having a direct effect on their classroom teaching. Some teachers reported that as a result of the collaborative's mathematics contest, they have begun to cover different content. Other teachers reported that they have used ideas they derived from a collaborative event, such as a card trick or a homework assignment, with their students. One teacher reported, "Students are more interested in math. Students learned new ideas and techniques through the Math Fair. The contest gave teachers an opportunity to teach new ideas and review ideas taught earlier."

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The 1987-88 school year seemed to have brought real change to St. Louis mathematics teachers. Their comments early in the year focused on problems and concerns; nine months later, the ten teachers who responded to the Diary of Professional Relationships interview questions related the experiences they had had and how these had increased their interest in teaching.

Mathematics Focus

A major focus of the collaborative during 1987-88 was the planning and conducting of the mathematics fair and contest. The purpose of these events was to draw the attention of teachers, students, administrators and the public to mathematics. The teachers on the planning committees for both of these events were responsible for the development of exhibits for the fair and test questions for the contest. Other teachers worked with students to prepare them for each event. Both events offered opportunities to students and teachers to explore areas of mathematics not typically covered in the curriculum. Although fully supportive of both events and very pleased with the results, the collaborative considered not continuing to sponsor the fair and contest; the Council felt that such events really should be a part of the district's normal program. The fair and contest will continue to be sponsored by the collaborative for at least one more year. However, the collaborative does see itself as serving as a testing ground for ideas that could then be adopted by the school district. Through financial support and administrative help, the collaborative proved that it is possible to bring teachers, students, and other professionals together to do and to discuss mathematics.

A second collaborative focus that began to emerge during the year involved current issues in mathematics education. A number of collaborative presentations, including the workshops on the Challenge of the Unknown film series and the Geometric Supposer, the IBM dinner symposium, and the NCCSM follow-up seminar, focused on the use of technology in the teaching of mathematics. The collaborative paid registration fees for a few teachers to attend seminars presented by the MSEC on topics such as problem solving and statistics. As a result of this focus on content issues, some teachers are looking at mathematics and the curriculum in a new way. One teacher noted, "It [the collaborative] helps me advise my students and explain why we are doing some activities the way we do. Whether I am or not, it makes me feel as though I'm on the 'cutting edge' of things." Another teacher writes, "I am a classroom teacher and had opportunities to notice the innovations and changes in the math curriculum. The Math Collaborative opened a window on the subject. I am now more informed than before. I can visualize the direction of the future--all with assistance from the collaborative."

A third teacher commented, "I have become aware of math trends." At least one teacher reflected on the differences between the materials presented through the collaborative and those that comprise the current curriculum. "The curriculum does not reflect the research and technology we have heard about in collaborative activities," the teacher noted.

A third area of collaborative interest is the teaching of mathematics to special groups, such as minorities and women. At this point, this issue cannot be considered a real focus of the collaborative, but a few related activities were conducted or supported by the collaborative during the past year. Uri Treisman's visit helped to raise issues related to teaching mathematics to minorities through group work. One important aspect of this activity involved watching a university professor work with high school students. One teacher noted that one positive effect the collaborative had wielded on a mathematics department resulted from the "math staff and students interacting with a nationally known university professor in a class setting."

The collaborative has made steady progress over the past year in its efforts to draw teachers' attention to some current issues in mathematics education. It appears that teachers are becoming more aware of current reforms in the content area. It will be important to observe the role the collaborative assumes in bringing these reforms into the classroom. A new district requirement that students graduating in 1990 and thereafter must have three years of mathematics forces the issue of what mathematics students will be required to have during those three years. It appears that their collaborative participation has developed in some teachers a new predisposition toward innovative and current approaches to the curriculum.

F. Next Steps

The collaborative's principal focus for the 1988-89 school year will be the mathematics curriculum. Study groups will be formed to review the new textbooks that all of the secondary teachers will receive. The collaborative will provide meeting space and refreshments for these study sessions. A long-range planning committee will be established to study issues of permanence relevant to the collaborative's continued growth and development.

SUMMARY REPORT:
SAN DIEGO URBAN MATHEMATICS COLLABORATIVE

by the
Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the San Diego Urban Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal for funding submitted by the San Diego Urban Mathematics Collaborative to the Ford Foundation; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM Conference in Chicago in April, 1988; and three site visits by the staff of the Documentation Project.

SAN DIEGO URBAN MATHEMATICS COLLABORATIVE

A. Purpose

The purpose of the San Diego Urban Mathematics Collaborative is to improve the professional lives of teachers in the San Diego area by reducing their tendency to work in isolation and by increasing the contacts that foster mutual support, professional growth, and involvement with the larger professional mathematics community. The collaborative has identified two long-term goals that it would like to see adopted by the local school districts and supported by community resources. The first is to provide teachers with opportunities to continue their education, either formally (i.e., through university courses) or informally (i.e., through conferences). The second goal is to foster the active participation of more teachers in the Greater San Diego Mathematics Council and to use the GSDMC as a vehicle through which teachers can organize and promote their own professional activities.

B. Context

The San Diego Urban Mathematics Collaborative serves the mathematics teachers in both the San Diego Unified School and the Sweetwater Union High School districts. Although these two districts are in relatively close geographic proximity to one another, each is unique in terms of the social and demographic context in which the collaborative must operate.

The San Diego Unified School District

The city of San Diego has a population of approximately 900,000 and is surrounded by a metropolitan area of about 2 million persons. The population is expected to increase by approximately 2.3 percent per year over the next ten years, the majority of which is expected to result from the immigration of ethnic minorities. Current census figures indicate that approximately 25 percent of San Diego County's population is comprised of minorities, but a large number of county residents are Mexican immigrants who have entered the country since the last census. Although the primary economic bases of the county are tourism, defense contracting (including a large naval base) and manufacturing, companies specializing in high technology have flocked into the area, creating the need for a more skilled labor force.

The San Diego Unified School District's (SDUSD) 153 schools serve approximately 117,000 students. The district has 107 elementary schools (grades K-6), 8 middle schools (grades 6-7, 7-8 or 6-8), 12 junior high schools (grades 7, 7-8, or 7-9), 15 senior high schools (grades 9-12 or 10-12), 9 atypical schools, and 2 continuation schools. Thirty-four of these are elementary magnet schools (grades K-6) and thirteen are secondary magnet schools (grades 7-12). Two magnets combine elementary and secondary students.

Magnet schools are designed to offer concentrated instruction in several specialized fields of study in addition to basic curriculum. Secondary magnet programs include business administration, creative and performing arts, and mathematics and science.

Of the total student population, 51 percent is male and 49 percent is female. Approximately 43 percent of students are white, 22 percent are Hispanic, 18 percent are Asian and 16 percent are black. Fifteen percent of SDUSD students consider English a foreign language. Twenty percent of students' families receive AFDC, and 41 percent are eligible for federally funded lunch programs. Enrollment is increasing, with Asians representing the largest percentage increase in the last five years, from 15 percent to 18 percent. Hispanics showed the second largest percentage increase, from 19.6 percent to 22 percent in the same time period. In contrast, the percentage of white students decreased from 49 percent to 43 percent since 1983.

Approximately 8,000 middle school students are enrolled in the SDUSD. Fifty-one percent are male, and 49 percent are female. Forty-one percent of middle school students are white, 23 percent are Hispanic, 18 percent are black, 18 percent are Asian and 1 percent are American Indian. Thirteen percent have English as a second language, and 52 percent are eligible for federally funded lunch programs.

In total, 9,000 seventh and eighth grade students attend SDUSD junior high schools (ninth graders are included in high school statistics). Fifty-two percent of these are males and 48 percent are females. Forty-three percent are white, 24 percent are Hispanic, 22 percent are Asian and 12 percent are black. Twelve percent of junior high students consider English a second language, and 35 percent qualify for federally funded lunches.

Of the 32,000 high school students in SDUSD schools, 51 percent are males and 49 percent are females. Forty-seven percent are white, 19 percent are Asian, 18 percent are Hispanic and 15 percent are black. One percent of high school students are of other ethnic backgrounds. Ten percent consider English a foreign language, and 20 percent receive federally funded lunch support.

Approximately 27,000 high school students are enrolled in mathematics courses each semester. Fifty-one percent of these are males and 49 percent are females. Twenty-eight percent of mathematics students are in the ninth grade, 27 percent are in the tenth grade, 27 percent are in the eleventh grade and 18 percent are in the twelfth grade. Forty-six percent of students enrolled in mathematics are white, 21 percent are Asian, 18 percent are Hispanic and 15 percent are black. Graduation requirements include six semester units of mathematics, as well as demonstrated proficiency in a series of examinations.

For the fall, 1988, testing session, SDUSD eleventh graders achieved scores on the Comprehensive Test of Basic Skills that equalled or exceeded those for the national norm in all ten sub-test areas. Scores on the combined ten mathematics scales had a median in the 70th percentile. In 1987, seniors who took the Scholastic Aptitude Test (SAT) achieved mean scores of 423 on the verbal scale and 485 on the mathematics scale, as compared with national norms of 430 and 476, respectively.

Sixty-nine percent of SDUSD high school graduates go on to post-secondary education in their first year after high school. However, twenty-six of every hundred ninth graders will drop out before graduating. A dropout is defined by the state of California as any student in grade 10, 11 or 12 who departed from school before graduation or completion of formal education (or its legal equivalent), and is not known to have returned to a school or other educational program by mid-October of the following school year.

SDUSD high schools employ 1,400 teachers. Fifty-five percent are men and 45 percent are women. Eighty-one percent of high school teachers are white, 8 percent are black, 7 percent are Hispanic, 2 percent are Asian and 2 percent are American Indian.

Of these, 227 teach mathematics. (These figures include twelve San Diego Community College instructors hired to teach calculus.) Fifty-seven are women and 170 are men. Eighty-seven percent of SDUSD mathematics teachers are white, 4 percent are Asian, 4 percent are Hispanic, 4 percent are black and 2 percent are

American Indian. Seventy percent of high school mathematics instructors hold at least a master's degree, and 98 percent have earned at least a bachelor's degree. All mathematics teachers are certified to teach in their subject area. Ninety-one percent are tenured.

The average teacher salary in the SDUSD is approximately $36,000 per year. Sixty-four percent of SDUSD teachers belong to the teachers' union, The San Diego Teachers' Association. In November, 1988, teachers negotiated a new contract that included a 2.5 percent raise on the schedule and a .5 percent bonus off the schedule. State Superintendent of Schools Bill Honig was instrumental in helping the district and the teachers reach this interim settlement. Everyone concerned agreed that continued disputes would be detrimental to a state initiative for generating more school funds. Official contract renewal dates and stipulations will be contingent upon recommendations from a fact-finding committee.

The SDUSD's 1987-88 budget totalled $480 million. Eighty-nine percent of funds comes from state and local sources, 10 percent originates from outside funding and only 1 percent of total revenues is received from the federal government. Expenditures for the 1986-87 school year totalled $490 million. A major issue facing the district is its increasing student enrollment and inadequate school facilities.

The Sweetwater Union High School District

The Sweetwater Union High School District is located in the city of Chula Vista, the southernmost city in the San Diego urban area, situated only four miles from the U.S./Mexican border. The population served by the district is primarily low-income, and the area is comprised of a mixture of residential, commercial and industrial regions.

Twenty schools--two middle schools (grades 7-8), two middle/junior high magnet schools, seven junior high schools (grades 7-9), one junior/senior high magnet school, and eight senior high schools (two grades 9-12 and six grades 10-12) make up the district. Seven schools (two middle/junior high schools, four senior high schools and one junior/senior high school) in the district are designated as magnet schools. Foci of the magnet programs include: computer science; mathematics, science and computers; business; language; college preparation; and creative and performing arts. One of the junior high magnets, the NOVA+ program, emphasizes analysis, discussion and composition as they relate to four academic areas: English, mathematics, science and social science.

A total of 27,000 students are enrolled in the Sweetwater Union High School District. Of these, 52 percent are Hispanic, 29 percent are white, 11 percent are Filipino, 4 percent are black, 3 percent are Asian/non-Filipino, and 1 percent are American Indian. The percentage of minority students has risen from approximately 50 percent in 1978 to 71 percent in 1988, with Hispanics showing the largest percentage increase (16 percent). Enrollment has increased over the same time period, from 22,000 students in 1978 to the current total of 27,000 students. Thirty percent of the student population is eligible for federally funded lunch programs.

Thirteen percent of the SUHSD student population have English as a second language. With the influx of limited English proficiency (LEP) students to the district, Sweetwater continues to face the issue of a shortage of bilingual mathematics and science teachers.

In total, 2,300 students are enrolled in the district's middle schools (grades 7-8) and 7,600 are enrolled in its junior high schools (grades 7-9). Fifty-two percent of the combined middle/junior high school student population are Hispanic, 29 percent are white, 11 percent are Filipino, 4 percent are black, 3 percent are Asian/non-Filipino and 1 percent are American Indians. Of junior high students, approximately 17 percent have English as a second language.

The SUHSD enrolls 13,000 high school students. Of these, 53 percent are Hispanic, 31 percent are white, 9 percent are Filipino, 4 percent are black, 2 percent are Asian/non-Filipino and 1 percent are American Indian. Sixteen percent of Sweetwater high school students consider English a second language. Although, on the average, students in the district scored above the national average on the Comprehensive Test of Basic Skills, and although 50 percent of high school graduates go on to post-secondary education, the dropout rate for Sweetwater schools is nearly 30 percent. Graduation requirements include three years of mathematics.

Approximately 1,100 teachers are employed by the district, all of whom have earned at least a bachelor's degree. Of these, 52 percent are women and 48 percent are men. Seventy-eight percent of Sweetwater teachers are white, 16 percent are Hispanic, 2 percent are black, 1 percent are Filipino, 1 percent are Asian/non-Filipino, and approximately 2 percent are from other ethnic origins. All Sweetwater teachers belong to a teachers' union. The current teachers' contract was approved in 1985 and is in effect until June 30, 1989. All teachers receive four paid release days for in-service or other teacher-training purposes.

The district's general fund expenditures for the 1986-87 school year totalled approximately $102 million, while the 1987-88 budget totalled approximately $106 million. The state of California provides approximately 70-75 percent of the total monies allocated to the district. The federal government provides 5-6 percent of the Sweetwater budget, and the remainder comes from local revenues.

Anthony J. Trujillo, superintendent of the Sweetwater Union High School District, came to the district four years ago from Marin County, one of the most affluent districts in the nation. One of his major goals has been to improve teaching, and he plays an active role in overseeing classroom instruction.

C. Development of the Collaborative

Collaborative Director Alma Marosz continued to provide leadership to the project during the 1987-88 school year. In September, Dr. Mary Koehler of the Department of Mathematical Sciences at San Diego State University joined the collaborative staff as co-director. Dr. Koehler devoted her energies to becoming familiar with the operations of the collaborative so that she would be able at some future date to assume the full responsibilities of the directorship. Jean Childs-Moore joined Frank Holmes as project coordinator in September, 1987, replacing Beth Schlesinger who returned to teaching. Ms. Childs-Moore coordinates and plans activities, and serves as the principal liaison between the collaborative and the administration of the Sweetwater Union High School District. Prior to joining the collaborative staff, Ms. Childs-Moore worked for the Data General Corporation as a software development consultant, taught in secondary schools for ten years, and served three years as the district administrator for the Sweetwater Union High School District's Technology and Grants Program. Ms. Childs-Moore previously coordinated the San Diego Mathematics Teacher Enhancement Program, a project of the Center for Research in Mathematics and Science Education that is directed by Dr. Ed Silver. Mr. Holmes, director of the minorities program at San Diego State University College of Engineering, helps with planning and personal intervention with schools. He continues to be the liaison between the project staff, the local minority community and the site administrators at the SDUSD target schools. The on-site observer is Dr. Sharon Whitehurst, the Affirmative Action Program Administrator for the San Diego City schools. Ms. Marosz and Ms. Childs-Moore have offices in a building that also houses the Center for Research in Mathematics and Science Education (CRMSE). The collaborative shares a secretary with the CRMSE staff.

Executive Committee

The Executive Committee, which is the SDUMC's key decision-making body, met once each month during the 1987-88 school year. Committee members include the collaborative staff, a department head or representative from each collaborative school, the mathematics supervisor from the San Diego Unified School District and the San Diego County Department of Education, the staff development coordinator from Sweetwater, and mathematics educators from San Diego State University (SDSU).

The Executive Committee met after school at a different collaborative school each month. Attendance ranged from ten to sixteen members. In October, a Japanese post-doctoral student and his major professor also were in attendance. Topics of discussion included the collaborative's focus, its budget, upcoming events, procedures for selecting the teachers who would receive funding to attend the NCTM Annual Meeting in Chicago, grant possibilities, Math A, and the payment of collaborative members' dues to GSDMC and to other mathematics teachers' organizations. The committee decided to pay the GSDMC membership dues for teachers from the three new schools and to share the cost of the dues for all other collaborative members.

Collaborative Schools

Mathematics teachers at the collaborative's six original schools were joined in September by their colleagues at three high schools: fourteen teachers from San Diego High School and eighteen from Lincoln High School in the SDUSD, and eleven teachers from Mar Vista High in the Sweetwater district. In selecting the schools, collaborative staff chose those they believed would benefit most from the collaborative experience.

The collaborative had planned to invite the teachers at three junior high schools to join the project in the spring of 1988, bringing the total number of collaborative teachers to approximately 120. However, the collaborative decided to delay expanding its teachers' base until 1988-89. There were two reasons for this decision. First, it took longer than had been anticipated to involve the senior high school teachers in collaborative activities, and second, one of the coordinators who was to oversee the process of integrating the junior high school teachers into the collaborative was ill for an extended period of time.

Linking with Industry

Work continued during the school year to establish firmer relationships between the collaborative and local industry. It is anticipated that the organizational structure of the collaborative may have to change as industry representatives become more involved. The collaborative director and coordinators have made contact with the Educational Advisory Committee of the local chapter of the American Electronics Association. The committee reports to the association, but is not directly involved with its chief executive officers, who are instrumental in establishing relationships between businesses and the collaborative. In February, Professor Marosz and Ms. Childs-Moore were invited to make a presentation to the AEA Educational Advisory Committee. Although the committee was very receptive to the presentation and expressed interest in participating in the collaborative, it did not follow up on the meeting or make any further efforts to become involved.

The San Diego High-Technology Industry and Education Consortium was established in 1986 to provide fellowships to allow teachers to work in local industries during the summer. The collaborative has tried to maintain a working relationship with the consortium, but a less than stable consortium management has made this difficult.

A wide variety of professional organizations serve the mathematics teachers in the San Diego area. The Greater San Diego Mathematics Council (GSDMC) is an 800-member affiliate of the National Council of Teachers of Mathematics and of the California Mathematics Council. The GSDMC sponsors several special events during the year. Mathematics teachers can also join the California Mathematics Council, which sponsors an annual meeting for members living in southern California in November. In addition, faculty members at SDSU are highly regarded in the field of mathematics education and are involved in numerous projects, including the California Mathematics Project under the direction of Dr. Nicholas Branca.

The San Diego Compact is the educational fund for the area. Jeanne Jehl, an administrator on special assignment out of SDUSD's office of the deputy superintendent, is working with Compact to help it become more viable. During 1987-88, Compact was an organization largely in name rather than in terms of its formal structure or activities.

During the summer of 1987, San Diego mathematics teachers were invited to participate in a staff development and leadership workshop sponsored by the San Diego

Mathematics Teacher Enhancement Program, directed by Dr. Edward Silver of San Diego State University.

A five-day, 40-hour workshop on staff development and leadership training was held at the County Office of Education in San Diego from August 17-21, 1987. The event was organized in response to interest expressed by participants in the San Diego Mathematics Teacher Enhancement Project. Jean Childs-Moore, who at that time was the coordinator of the project, led the workshop, which focused on training in five areas: Mathematics Framework (How to Present it), Leadership Effectiveness, Team Building, Grant Writing, and Learning Styles. Sixteen teachers, including four collaborative teachers, participated.

D. Project Activities

The collaborative's major strategy focuses on promoting networking among existing resources in the San Diego area rather than creating new ones; the project makes every effort to encourage teachers to take advantage of the opportunities already available to them. However, because resources and services do not always reach the mathematics teachers who need them most, the collaborative does sponsor a select few activities. In addition, the collaborative leadership believes that one effective way to foster professional growth is to enable as many teachers as possible to attend major mathematics conferences and workshops offered by other organizations during the school year. The collaborative sponsored teachers to attend several conferences and workshops during 1987-88.

Workshops

California Mathematics Framework Workshop Series

The collaborative sponsored a series of four Saturday morning workshops to address topics related to the *California Mathematics Framework*, the guidelines for K-12 mathematics education for the State of California. The workshops were held from 8 a.m. to noon on December 12, January 16, January 23, and February 20. Teachers had the option of receiving a $50 stipend for each workshop ($200 for the package), or district hurdle credit for completing all four workshops (if approved by their individual districts).

Problem Solving. Twenty-five collaborative teachers attended the first workshop, which was held December 12, 1987, at National City Junior High. Dr. Nicholas Branca of San Diego State University discussed problem-solving applications in the classroom, a topic the teachers had requested.

Participants felt that the workshop was very valuable. All but two of the twenty-five teachers who completed written evaluation forms rated the overall workshop, its objectives, and the usefulness of the ideas and activities presented as a 4 or 5 on a 5-point scale (with 5 representing "excellent"). One teacher said, "I thought that some of the things were excellent. I've used them with my classes." Another commented, "A strong feature was the fact that we modeled 'wrong' techniques and discovered it ourselves. Excellent presentation. We need an advanced version later." A third teacher wrote, "Nick is great--creative. The problems were thought provoking and fun. The handouts will be beneficial."

Introduction to Logic and Problem Solving. On January 16, 1988, Alma Marosz, the collaborative director and a mathematics professor, presented the second workshop in the series, "Introduction to Logic and Problem Solving." Twenty-eight collaborative teachers attended the Saturday morning session, which was held at National City Junior High.

The participants indicated that the workshop was very useful, although several noted that the logic unit was not very relevant for junior high teachers. One teacher said, "I really liked the workshop. The fellowship and working together is really great--the gathering of people from different sites and the resulting interaction is terrific." Another said, "Alma did an excellent job of presenting the subject matter. Fast paced with lots of material. This was personally beneficial although some of the concepts would be beyond the students I teach. The activities will be useful to give students some intuitive understanding of logic."

Computers and Math/Geometric Supposer. The third Saturday morning session was held January 23, 1988. Participating teachers attended one of two workshops: "Computers and Math" or "Geometric Supposer," both led by collaborative teachers who had attended the Phillips Exeter Academy in New Hampshire in the summer of 1987. Milo Hallack, National City Junior High School, led the "Computers and Math" workshop. Renee Harris, Granger Junior High School, led the "Geometric Supposer" workshop.

Twelve collaborative teachers attended the Geometric Supposer workshop, which was held at Granger Junior High School. Of the six teachers who returned evaluation forms, five rated the workshop 4 or higher on a 5-point scale in terms of its overall value, its objectives, and the usefulness of the ideas and activities presented. One teacher wrote, "The workshop was organized; lots of time to discover. Great pacing!" Another said, "Adding the workshops is a great motivator--I enjoy them and hope to see more."

The nineteen teachers who attended the workshop "Computers and Math," held at National City Junior High School, also felt that the workshop was very useful. Sixteen of the seventeen teachers who returned the written evaluations rated the workshop a 4 or 5 on a 5-point scale in all categories. The teachers seemed especially pleased with the hands-on aspects of the experience. One teacher wrote, "It was a very good demonstration. Very friendly and relaxing learning environment." Another wrote, "[The workshop] introduced me to software that is available and let me play enough to really know what the software is all about." A third teacher said, "Very helpful for computer scaredy-cat." Another teacher commented, "Excellent--let's have more of these."

Mental math, estimation, and hands-on geometry. On February, 29, 1988, the final workshop in the four-part series was held at National City Junior High School and was led by Millie Prior, collaborative teacher and chair of the Mathematics Department at Bell Junior High School. In this workshop, Ms. Prior demonstrated a hands-on approach to teaching informal geometry in the middle grades. Activities included making paper models of geometric solids and informally proving area and volume relationships with paper, scissors, grid paper and popcorn. Ms. Prior explored mental math and estimation activities for the middle grades utilizing a myriad of collectible items and appropriate mental math/estimation strategies.

The twenty-eight teachers who attended felt the workshop was very helpful. One teacher said, "[A strong feature of this workshop was] the materials available to motivate students and to relate concepts....The workshop was very enjoyable and well done. Very good ideas and presentation. Thanks." Another said, "Excellent material and presenter." A third said, "Items presented are readily applicable to math classes."

Many teachers commented that they enjoyed the entire Saturday morning workshop series. One teacher said, "Thank you so much for a really enjoyable experience. We need to have more of these types of things."

NCTM Standards Workshop

On April 23, 1988, the collaborative and the San Diego Math Project co-sponsored a workshop on the NCTM *Standards*, at San Diego State University. The workshop, which was funded by state funds and directed by Professor Nicholas Branca, was designed to provide teachers with an overview of the new NCTM *Standards* and an opportunity to compare the *Standards* to the *California Math Framework*. Approximately fifty teachers from the San Diego area participated, including the department head and one other representative from each collaborative school, and about thirty teachers from the San Diego Math Project. All of the participants came to the meeting with some knowledge of the *Standards*; some had reviewed the entire document, some had attended informational sessions at NCTM in Chicago, and others had reviewed at least an abridged version.

The morning began with an overview of the *Standards*, followed by a panel discussion by teachers who had attended NCTM's annual meeting in Chicago. After a break, teachers reassembled by grade level in ten small groups to discuss the *Standards* and to develop recommendations for the NCTM committee.

In general, participants expressed support for the *Standards*. Many viewed it as a much-needed document; all agreed that the *Standards* would be a real challenge to implement.

Participants expressed their appreciation that the collaborative had offered a workshop on the *Standards*. They also were pleased with the high quality of the presentation. One teacher said, "I liked the workshop. The way it was done and the fact that we did it was very good. It's difficult to get teachers into workshops like this without extra pay." Another commented, "I got to talk to elementary teachers and also high school teachers to find out what their concerns were." A third said, "I thought that it was good. We got to talk to our colleagues."

Increasing Students' Mathematics Achievement Workshop

On December 1, 1987, Lola May, a well-known textbook author and mathematics education lecturer from the Winnetka, Illinois Public Schools, led a workshop, "Increasing Students' Mathematics Achievement by Breaking Through Basic Skills to Critical Thinking" at the Catamaran Hotel in San Diego. The goal of the workshop, which was sponsored by the Bureau of Education and Research, was to assist mathematics teachers in increasing students' mathematics achievement. The collaborative sponsored the attendance of five teachers.

The teachers were very enthusiastic about the workshop, and they expressed their appreciation for Ms. May's presentation. Ms. May, who is well recognized as a dynamic, inspiring speaker, typically presents a workshop in San Diego once each year, often for elementary math teachers. One teacher commented, "It was very good. She was terrific. It was definitely worth it. The book, the information, everything. Also her enthusiasm. The whole thing was worthwhile." Another added, "She's fantastic. It's amazing how that woman can keep coming up with exciting things. For once, I have heard someone come up with some reality. She's a real teacher. Other speakers don't really teach. They talk about it. She said 'I demand to have a general math class every year.' She said that's the real world." A third teacher said, "I liked it a lot. It was very motivational and gave us good activities."

Collaborative Retreat

The second annual retreat for the teachers and staff of the San Diego Urban Mathematics Collaborative was held October 30, 1987 from 4-10 p.m. at the Doubletree Hotel in Mission Valley, San Diego. Registration was greater than anticipated, with seventy-seven teachers attending. The level of response from the collaborative's new schools was especially surprising, with fourteen of thirty-three teachers registering to attend. Participants received a $50 stipend.

Following a registration period and a social hour, two concurrent sessions were offered: "CAP Results for Junior High School" and "New 12th Grade CAP Test." Participants then selected three 30-minute mini-workshops from a variety of offerings, including "Problem Solving and Writing in Remedial Math"; "Math A Topics"; "Geometric Games, Grades 7-12"; "Using Calculators to Find Patterns"; "Geoboard Geometry, Grades 7-12"; and "Geometric Supposer Video, Grades 9-12." The workshops were led by collaborative administrators, SDSU faculty and collaborative teachers. A dinner following the workshops allowed the participants from the various collaborative schools to interact and share ideas. The collaborative also used this time to register all of its members with the Greater San Diego Mathematics Council, paying the $6.00 membership fee for new collaborative members and half of the fee for "veteran" members. Two-hour discussion sessions followed dinner, with separate articulation sessions for the Sweetwater Union High School and the San Diego Unified school districts. These articulation sessions were later summarized, written, and printed for distribution to each collaborative teacher and site principal.

The teachers appeared to enjoy the retreat, and they participated in the sessions and discussions with great enthusiasm. In general, they indicated that the event was well organized and well paced, although a few teachers complained about the late hour of the articulation sessions, particularly since the retreat was held on a regular teaching day. The teachers seemed to especially enjoy the interaction with other participants. One teacher said, " I enjoyed the exchange of ideas and the bringing together of the teachers of mathematics. I feel like I've been brought out of isolation." Another said, "I appreciate the work of the directors and all the people who put this retreat together. Getting together like this makes me feel like I've been regenerated and brings me closer to the others who also teach." A program evaluator from the City Schools said, "There were some good workshops. The teachers were really interested in the CAP results. The collaborative is doing a great job."

Industry Applications Workshop and Tour

On May 24, 1988, the collaborative sponsored an industry applications tour of Teledyne Ryan Electronics Corporation. Fifteen collaborative teachers participated, as well as two teachers from Teledyne Ryan's Partnership School, Madison High. The tour was initiated by a Teledyne representative who attended a presentation made by the project director and coordinator to the Educational Advisory Committee of the American Electronics Association. Prior to the visit, Professor Marosz met with Teledyne engineers and toured the site to help determine what would be of interest to teachers.

The event began with a presentation by a retired engineer on the mathematics background students need to become engineers and a presentation by a research engineer on antenna construction using phased-array technology. Teachers also received printed materials on the technology, and toured the plant where other topics of discussion included quality control, how to determine tolerance levels, how to operate equipment such as the Computer Assisted Design (CAD) system, and the mathematics backgrounds of non-degree technicians.

The teachers were very impressed with the workshop. For some, it appeared to be a significant step in their professional development. One teacher commented, "It's really helpful for teachers who never get out into the real world to learn what is out there. It really tells us as teachers why math is important." Another added, "I liked it very much. Very informative. I learned something about rays in relationship to satellite and communications. Good idea for more workshops like this." Another said, "I did enjoy it. The atmosphere was one of collaboration."

"Stand & Deliver" Preview and Reception

On March 28, 1988, the collaborative invited the principal and department chair from each collaborative school to attend a special reception and advance private screening of the movie "Stand and Deliver." The event, which was held at Horton Plaza United Artist Theater, was co-sponsored by the California Chicano News Media Association and Warner Brothers. The movie portrays the story of Jaime Escalante, a mathematics teacher in Los Angeles whose high school Latino students passed the Advanced Placement Calculus test in spite of language barriers, poverty and other hardships. Eighteen collaborative members attended, including several whose attendance was not sponsored by the collaborative.

Everyone who attended found it an inspiring experience. The on-site observer said, "It was one of the most exciting events that I have ever attended. The theater was packed. The pre-reception was crowded and the question-and-answer session was extremely helpful." One teacher commented, "It was a thought-provoking film." A principal said, "It was outstanding. I wished that I could have had all of the teachers there." Another teacher added, "I wish that I could take my students to see it."

Mathematics Library

At the October, 1987 retreat, the collaborative had distributed six packages, each containing eighteen books related to mathematics research, instruction, activities, and methods. A package was provided to each of the six original collaborative schools to serve as the foundation of a permanent resource library at each site. A label in each of the books indicated that it had been donated by the SDUMC. In providing these materials, the collaborative was able to reach many teachers who had not participated in any of the project's other activities. Feedback from the sites was very favorable. Teachers appreciated having access to materials that offer suggestions about ways to implement the *California Mathematics Framework* in the classroom. The collaborative will continue to provide sets of materials until all schools have acquired them and will continue to promote the idea of a permanent mathematics resource area at all sites. It is intended that these materials will serve as the foundation of a resource library and will prompt teachers to initiate activities to secure more of the materials they need for instruction.

National Student Weather Experiment

On April 25, 1988, during National Science and Technology Week, the collaborative sponsored three schools' participation in the Student National Weather Service Experiment National Balloon Launch. The collaborative paid for balloons and packets of materials. Students at Keiller Middle School, National City Junior High, and San Diego High School released 2,500 balloons in the experimental launch. The bureau planned to track the course of the balloons and subsequently provide data to students and teachers on wind patterns across the United States. In February, participating schools received pre-launch packets that provided background on weather patterns and gave students a basis for predicting the course their tagged balloons would follow. Postcards were attached to the balloons and addressed to the young student scientists. People finding the balloons were asked to send the postcards back to the students, identifying the balloons' eventual landing sites. Last year, one San Diego student received a postcard from South Carolina, only three days after his balloon had been launched. This was an exciting event for the collaborative's teachers and their students, and it was also quite colorful. The launch was covered by two local television stations and the L.A. Times.

Grants and Scholarships

The collaborative kept teachers informed about the variety of grants and scholarship programs available during 1987-88. In the GTE grant program, for example, awards are made to pairs of science and mathematics teachers. The teachers must submit a proposal for a project that will impact on their students. If the proposals are accepted, the teachers receive $2,500 to fund their project and to sponsor their attendance at professional meetings. Grants awarded through Project TIME, which is funded by NSF and the State of California, allow teachers to attend a University of California-Santa Barbara conference on staff development, curriculum, and leadership issues in mathematics and science education. Other grants that were available included California Math Council scholarships, and scholarships from the TANDY Corporation. One collaborative teacher won a scholarship to the Summer Math Project at Mount Holyoke.

While only one collaborative teacher took advantage of these grant opportunities, the collaborative intends to continue to encourage teachers to apply.

Conferences

Annual Conference of the Southern Section of the California Math Council

On November 13-14, 1987, the Southern Section of the California Math Council (CMC) held a conference in Long Beach, California. As part of its effort to encourage teachers to establish contact with the broader professional mathematics community, the collaborative offered stipends to cover the conference registration fee, travel, and accommodations. More than twenty collaborative teachers attended the conference, which included a collaborative-sponsored wine-and-cheese reception.

The teachers who were interviewed after the conference felt that the event was very worthwhile. One teacher commented, "I always get a lot of good ideas. They draw a lot of top people. The Southern California Conference is always good." Another added, "Absolutely worthwhile." A third said, "I went to a couple of sessions that were superb!" A few teachers expressed disappointment that some of the sessions they had hoped to attend were full; they recommended that next year the collaborative teachers register for workshops in advance.

Some collaborative teachers attended the conference as presenters and presiders. The collaborative has worked to foster the professional development of teachers who are able to and are interested in leading workshops at major conferences.

Greater San Diego Mathematics Council Annual Conference

The collaborative paid the registration fees for approximately eighty-five teachers from the target schools to attend the annual convention of the Greater San Diego Mathematics Council on February 5 and 6, 1988, at the San Diego Convention and Performing Arts Center.

In general, the participants were somewhat critical of the conference, expressing the concern that the local conference cannot compare with the regional one in Southern California. One teacher commented, "I think that Long Beach and the [GSDMC] workshops get to the point where the same things are being said. The workshops are repeating themselves." Another added, "I didn't think that there was as much available as the year before. . . . It wasn't as good as last year." A third said, "The local conference is not able to draw people like the Southern California one." The on-site observer said, "There has been a general complaint about the local conference's failure to address the needs of secondary math teachers. It tends to focus on elementary teachers."

As with the CMC conference, collaborative teachers have begun to take a more active role in leading sessions at the local conference. Five collaborative teachers were presenters. One of the collaborative teachers who was interviewed after the conference said that seven of the teachers from his/her school were presiders.

"Computer-Using Educators" Conference

Two collaborative teachers received collaborative funding to attend the Fall "Computer-Using Educators" Conference (CUE). CUE, a professional organization for computer users, is comprised of six special interest groups organized statewide. Dr. Bernie Dodge of SDSU started CUE in 1983 and the organization has now expanded statewide.

Annual Meeting of the National Council of Teachers of Mathematics

The collaborative offered to fund up to twelve teachers to attend the annual meeting of the National Council of Teachers of Mathematics (NCTM) in Chicago, Illinois, April 6-9, 1988. The collaborative paid for airfare, conference registration and hotel accommodations, but it did not cover the cost of meals or substitute teachers. To apply, teachers submitted a one-page form in which they identified a topic that they planned to concentrate on at the conference; provided a rationale for the topic selection, taking into consideration their school's and their department's needs in mathematics instruction; provided a plan for disseminating their new knowledge and experience to colleagues; and outlined what they hoped to gain personally from the experience.

Twelve applications were received, which was not as great a response as had been anticipated. The collaborative financed ten teachers to attend the conference, while the two additional collaborative teachers who had applied were sponsored by the San Diego Unified School District. Prior to the conference, the collaborative held a meeting for all participants to encourage them to bring back from Chicago as much information and insight on the NCTM *Standards* as possible.

The teachers who attended the conference felt it was useful and productive. One teacher said, "I thought that it was wonderful. The sessions were really nice." Another commented, "Very useful. I'm applying things that I learned. I'm using cooperative learning in several of my classes." A third teacher said, "I thought it was good. We got to talk to our colleagues."

A math specialist from the school district said, "It was an excellent workshop." The on-site observer said, "The NCTM conference was good. The collaborative workshops were even better. Having the collaborative participants meet at the end of each day was a nice touch. The workshops were substantive."

Regional NCTM Conference

The collaborative sponsored a teacher to attend the regional meeting of NCTM, held in Phoenix, Arizona on October 22-24, 1987. The teacher shared information from the conference with colleagues at department meetings.

National Conference on Mathematics Reform and Teacher Professionalism

The collaborative sponsored the attendance of Collaborative Director Alma Marosz, Coordinator Frank Holmes, and teacher (and former coordinator) Beth Schlesinger at the Mathematics Reform and Teacher Professionalism conference at the North Carolina School of Science and Mathematics in Durham, North Carolina on June 23-24, 1988. The conference was designed to inform and guide the broader mathematics community in its effort to improve mathematics at the precollege level. Sponsored by the Durham Mathematics Council, with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives. The impact of recent curriculum development projects and teacher training programs on the mathematics reform movement were also examined.

Conference on Computers in Secondary School Mathematics at Phillips Exeter Academy

The collaborative covered the costs of airfare, registration, housing and meals for three collaborative teachers to attend the fourth annual Conference on Secondary School Mathematics and Computers at Phillips Exeter Academy in New Hampshire, from June 26 to July 1, 1988. The teachers who attended were Renee Harris, Karen Waddel, and Tim McKenny. The conference focused on the impact and applications of computers in the mathematics curriculum of today and tomorrow.

Teachers interested in attending the conference were required to submit an application outlining how knowledge from the conference would help with their teaching, how attendance would help their departments meet their goals, and what the teacher hoped to gain personally from the experience. In addition, the teachers had to agree to conduct collaborative workshops upon their return.

The three teachers who were selected to attend the conference differed somewhat in their evaluations. One teacher felt that the conference was extremely useful. She said, "It was wonderful! I went last year, too. It was quite the same. There was lots of information. The attitude of the people was great." While another teacher felt that "the conference was interesting," she was unable to get into the seminars of her choice, and her dormitory accommodations were unsatisfactory; these situations seemed to detract from her appreciation of the event.

Making Every Minute Count

The collaborative sponsored the attendance of two teachers at the one-day California Elementary Education Conference, "Making Every Minute Count" held on November 6, 1987.

Mathematics Association of America (MAA) American High School Examination

The collaborative purchased registration materials for collaborative teachers at San Diego High School and Sweetwater High School who wanted to sponsor students to take the 1988 American High School Examination given by the Mathematics Association of America (MAA).

E. Observations

Project Management

The Executive Committee is instrumental in developing program ideas and defining collaborative policies. Teachers play an active role on this committee, as do university professors and a district mathematics supervisor. While the organizational structure of many of the other collaboratives includes a board of directors that makes policy and a teachers' group that makes program decisions, the SDUMC's Executive Committee serves both of these functions. Because a representative of each of the nine collaborative schools sits on the Executive Committee, the group also serves to disseminate information to the collaborative teachers.

A noticeable change has occurred in the attitudes of the teachers who serve on the committee. Early on, their input and discussion focused on practical details and the shortcomings of the district administration. Over time, however, these teachers have shifted their attention to larger issues, and to consideration of the ways the collaborative can make a difference. They have come to value their committee involvement to the extent that many have invited their colleagues to attend its meetings. One of these guest teachers commented, "[The meeting] boosted my morale. It was very useful." It is clear that the Executive Committee's role extends beyond collaborative decision making to provide educators an opportunity to share ideas and to discuss relevant issues.

Another key element of the collaborative's organizational structure is its administrative group, which consists of co-directors, co-coordinators, and the on-site observer. This management group met during the year on an as-needed basis to coordinate efforts and to discuss details of activities. The size of the collaborative's administrative staff made these meetings essential to an efficient, effective decision-making process. In many ways, the management team meetings provided the administrators with a forum for problem solving and brainstorming.

San Diego is the only one of the collaboratives that has appointed co-directors and co-coordinators. This administrative structure facilitates a smooth transition as the collaborative moves toward establishing a single directorship. While this is a viable way of passing the reigns, it is particularly well-suited to San Diego's situation. Ms. Marosz donates her time so that the collaborative can afford to pay Dr. Koehler for her collaborative participation. Also, it is generally assumed that the director will come from SDSU's mathematics education faculty; this provides the collaborative with a specific group from which to identify the next director rather than having to initiate a search for someone outside the local mathematics community.

The co-directors have divided administrative responsibilities between them. Ms. Marosz remains the strong force that provides direction and leadership to the collaborative. During the 1987-88 school year, Dr. Koehler spent most of her time shadowing Ms. Marosz and attending various collaborative functions in order to develop a deeper understanding of the project and its functions. Dr. Koehler also planned the *Standards* Workshop with the help of another SDSU mathematics education faculty member. It is expected that, in coming months, Dr. Koehler will assume a larger role in planning and conducting activities while Ms. Marosz concentrates on developing connections between the collaborative and local industries.

In contrast to many of the other collaboratives, the San Diego UMC serves teachers in two distinctly different districts. This situation was a major consideration when the collaborative decided to appoint co-coordinators. Ms. Childs-Moore has had a great deal of experience working with the Sweetwater School District and was able to provide a link with the district that had not existed prior to her involvement. Some of the work of the coordinators has been divided by district so that teachers have been able to establish personal, one-to-one relationships with either Ms. Childs-Moore or Dr. Holmes. Ms. Childs-Moore's responsibilities also include tasks that typically are assigned to the coordinators of other collaboratives, including making arrangements for workshops, preparing announcements, and writing annual reports. On occasion, two members of the administrative staff work as a team to visit departments and plan workshops. As yet, issues of project financing and fund raising have not arisen. In addition to the Ford Foundation funding, the university and the school districts contribute much of the collaborative's budget, with less than 10 percent coming from other sources. The San Diego State University Foundation remains the funding agent.

The collaborative has controlled its own growth and development by limiting its membership to an agreed-upon number of schools. This approach offered some advantages unavailable to the projects that were open immediately to all schools in a district or city. One advantage, for example, is that the collaborative administration had ample opportunity to become acquainted with the teachers in the mathematics departments in all of the collaborative schools and to provide special assistance to meet the particular needs of each school.

Collaboration

Progress has been made during the year towards establishing networks among teachers and fostering a sense of shared professionalism and collegiality. This has been particularly true on a departmental level, where teachers within a single mathematics department have begun to share information and ideas. Progress also has been made toward establishing relationships between teachers and those in industry; the collaborative's first industrial tour at Teledyne Ryan Electronics was one step toward this goal.

The collaborative's decision to limits its membership allowed it to expend whatever time and energy was needed to establish collegiality at each individual school. In some cases, departmental meetings hadn't been held in recent history. Despite this, the collaborative coordinators and directors were able to schedule departmental meetings, thereby providing a forum in which issues were raised and interest in the collaborative was generated. Teachers also began to appreciate the value of meeting regularly as a department. For some teachers, this development is viewed as a collaborative achievement. As one teacher said, "We've grown at our site. We're stronger as a unit."

Over the past year, the collaborative administration has become increasingly aware of the importance of helping departments to become active working groups. At one of the collaborative's junior high schools, for example, a young teacher with very little leadership experience was appointed mathematics department head. A collaborative co-director and co-coordinator helped her set agendas and conduct three meetings. By that time, the new department chair had become comfortable enough to choose her own direction, to set the agenda and to help the department begin to develop plans. Concurrently, the department head and some of the other teachers from the department became very active in the collaborative. From this and other similar experiences, the collaborative has developed a strategy for working with individual departments that emphasizes to a great extent the importance and value of a cohesive, active and functioning mathematics department.

This approach was more appropriate in some schools than in others because some departments already were functioning very well. Even in these departments, however, interaction between teachers from different schools was infrequent and sporadic. One teacher reported, "[Workshops] have helped, but now we do things with other schools. We had a joint department meeting with Keiller. We had a lot of common things to share." Another teacher noted that the collaborative had provided her with opportunities to meet other teachers in the district and that the collaborative was responsible for a "greater sense of community." One key goal of the retreat was to bring together teachers from a variety of schools.

Some teachers have noted that their interaction with university representatives and with Teledyne employees during the industrial tour has been helpful. One teacher observed, "[The] most significant changes [attributed to the collaborative] was having university professors share with us." Another teacher appreciated the tour of Teledyne Ryan so much that she wanted to share the experience with others: "I have already talked to four teachers at my site about the business/industry workshop." These accomplishments and this widespread recognition that change is occurring is particularly encouraging given that the San Diego UMC is relatively young compared with the first wave of collaboratives. In its second year of existence, teachers already are talking about the new relationships they have established with their colleagues and with those from industry and higher education.

The collaborative's development over the past year has also revealed some areas that may require the project's attention and energy during 1988-89. It appears, for example, that teachers in the lower grades are more willing to participate in collaborative activities than are their counterparts in the high schools. One exception to this was the October retreat, when a large number of teachers from the newer targeted high schools participated. Another aspect of the collaborative's efforts that has developed more slowly than other aspects has been the involvement of business and industry. It should be noted, however, that the districts do provide other opportunities for school-business interaction through an Adopt-a-School Program sponsored by the SDUSD and a speakers program administered out of the county office of education.

Professionalism

Many teachers in the San Diego and Sweetwater school districts have increased their involvement in professional activities because of their affiliation with the collaborative. They are attending more professional conferences and meetings, locally, statewide, and nationally. For some teachers, these are the first professional conferences they have attended since the passing of Proposition 13. This renewed activism has prompted many teachers to assume leadership roles, some for the first time in their professional careers. The San Diego area has long enjoyed the enrichment opportunities provided by the Greater San Diego Mathematics Council; the collaborative has built on the strengths of this organization and has increased its membership by paying teachers' annual membership dues.

Asked about the impact of the collaborative on their professional lives, teachers offer a variety of comments. One teacher cited her membership in several professional organizations, such as NCTM, GSDMC, CMC, and MAA. Another teacher reported, "I've become more active. I have become a leader and taken more of a leadership role at the site and in the district." A third teacher had observed changes within her department and reported that she is working to make things better: "We're [the department] talking about things that we never talked about before. . . . I was upset about working conditions [at my school] when I first went there. Now I work with the staff to improve conditions."

At least some teachers in San Diego view themselves as professionals but, as one teacher described it, "more as a police officer rather than a doctor or lawyer." In spite of their own professional pride, many teachers feel unappreciated by the general public. One teacher said he would not recommend that his children go into the teaching profession as it now exists. Asked about the changes he deemed necessary, this teacher cited higher salaries and more decision-making power. Another teacher reported that her husband, a stockbroker, did not consider her work to be as important as that of his co-workers in business. These two teachers were joined by others in agreeing that they did not feel highly valued by the community.

The collaborative appears to be addressing this issue of teachers' professional status and self-perceptions by providing them with a group identity and a source of support and recognition. In response to a question about the most significant changes that could be attributed to the collaborative, a teacher commented, "It gives us all a sense of belonging. Something greater than a school or district. [It provides] first class treatment of teachers for the first time." Another teacher reported, "I guess I feel more a part of a group instead of working on my own. We're in this together."

Mathematics Focus

The mathematics focus of the San Diego Urban Mathematics Collaborative is firmly centered in the *California Mathematics Framework* and current curricular reform. The *Framework* served as the basis for the collaborative's four winter workshops, and one of the project's best-attended events was a meeting on the NCTM *Curriculum and Evaluation Standards*. The collaborative's strong emphasis on mathematics reform reflects the interest of the SDSU mathematics educators who sit on the Executive Council, including the co-directors. But just as importantly, it also reflects the environment of change that characterizes the education community in San Diego. There is a strong push in both school districts to eliminate general mathematics from the high school curriculum. In the SDUSD, the pressure is being exerted by the district because the curriculum is more centrally controlled; even here, however, the district is moving toward more school-based decision making. In Sweetwater, principals play an important role in curricular decisions and are essential in implementing change.

Within this context, the collaborative has played an important role in enhancing teachers' knowledge of topics and current issues related to curriculum reform, not only in the state but in the nation. Asked whether the collaborative had increased teachers' awareness of current trends in mathematics education nationwide, one teacher responded, "Definitely. It's opened my eyes. There are common interests and goals nationwide." Another teacher reported, "Oh, definitely, because of my attendance at the national conference and also the *Standards* workshop. I had heard the term 'Standards' tossed around but did not know what it meant until we became involved in the collaborative."

A department head described the four workshops and how they have helped: "Personally [they have] enlightened my views on math . . . greater in depth [view] of what we should be doing and the direction we should be going . . . " There is some evidence to suggest that in at least two junior high schools, some current trends in mathematics education are being applied. For example, in both schools, calculators either were available or were being used in the classroom. At one school, a teacher treated the calculator as simply an alternate way of computing the task at hand, which required students to find ratios. At another school, cooperative learning groups were being used by teachers in two separate classrooms. It is difficult to attribute these activities directly to the collaborative, but they are consistent with activities supported by the project. For example, the collaborative sponsored a cooperative learning group workshop in 1986-87.

Another issue unique to San Diego is the difference in mathematics background between those teaching junior and senior high school. This diversity in training and education has made it difficult to plan or present a single workshop that would be appropriate for all collaborative teachers. An example of this problem is the logic workshop presented in January, 1988. One junior high school teacher had just moved to San Diego from Florida after graduating with a degree in elementary education, which generally does not include a great amount of preparation in mathematics. Also in the audience were senior high school teachers who generally hold at least a mathematics minor. The workshop presented activities that were designed to give the participants a better knowledge of logic and ideas they could use with their students.

The presentation was centered on the premise that logic is used in all kinds of life situations and is a fundamental aspect of all mathematics. Despite this approach, several comments on the evaluation form suggested that some teachers had difficulty perceiving the relevance of the topic and its importance to their classroom activities. It is important to note, however, that many teachers did attend the workshop for the purpose of learning more about mathematics.

Teachers in the San Diego Urban Mathematics Collaborative sustain a strong and enthusiastic interest in mathematics. Over the past two years, this interest has been generated by the leadership of the SDSU and maintained by the teachers, who consistently want to know more. Leadership is beginning to emerge from among those teachers who have been actively involved in the collaborative, as evidenced by those who have presented mathematics workshops to their peers. It will be interesting to observe whether this new leadership can be sustained and expanded such that the collaborative's mathematics focus and activities are defined and implemented by the teachers.

F. Next Steps

In keeping with its strategy of addressing the needs of individual departments and enhancing teachers' mathematics knowledge, the San Diego Math Collaborative will continue to plan and present a variety of workshops and enrichment activities during 1988-89. Jaime Escalante, the Los Angeles mathematics teacher portrayed in the movie "Stand and Deliver," has been invited to San Diego to meet with the principals and mathematics teachers from the collaborative schools. A series of workshops on a wide array of mathematical topics will be part of a weekend-long retreat for San Diego teachers at Lake Arrowhead. The collaborative will continue to offer workshops and seminars on topics to be decided by the Executive Committee, with input from individual departments. Finally, a five-day workshop on "Contemporary Topics in Mathematics Using Technology" is planned for August 29-September 2, 1989.

SUMMARY REPORT:
SAN FRANCISCO MATHEMATICS COLLABORATIVE

by the

Urban Mathematics Collaborative Documentation Project
University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the San Francisco Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the San Francisco Mathematics Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting in San Diego in February, 1988; meetings held in Chicago during the annual NCTM Conference in April, 1988; survey data provided by teachers; and five site visits by the staff of the Documentation Project.

SAN FRANCISCO MATHEMATICS COLLABORATIVE

A. Purpose

The purpose of the San Francisco Mathematics Collaborative, as stated in the original funding proposal, is to show teachers "how mathematics is imbedded in the world around us, while being sensitive to the needs and interests of the teachers involved in the program." This statement of purpose continues to provide direction for the collaborative.

The collaborative has identified three major goals. The first involves teachers' professional development as mathematicians and educational leaders. The collaborative will work to develop leadership skills in teachers and department heads, provide seminars to inform teachers of new developments in discrete mathematics and research in mathematics learning, and provide opportunities for teachers to serve as mentors and to attend conferences. The collaborative's second goal is to build collegiality among teachers, and networks between teachers and other mathematics professionals. Mathematicians from the business, industry and university communities will be invited to collaborative activities, and the collaborative will continue to work closely with the Exploratorium and with other local institutions. The project's third major goal is to enable teachers to infuse into their instruction a sense of the imbeddedness of mathematics in the real world. The collaborative will work to develop teacher awareness of the changing world of mathematics by presenting bi-monthly seminars on topics related to discrete mathematics, sponsoring Summer Institutes, and awarding teachers grants to fund classroom projects.

B. Context

Approximately 700,000 residents live within the city limits of San Francisco, which comprises the entirety of San Francisco County. The San Francisco Unified School District (SFUSD), which serves approximately 64,000 students, is comprised of 110 schools (grades K-12), of which fourteen are middle schools (grades 6-8), seven are comprehensive high schools with populations ranging between 1,500 and 2,800 students (grades 9-12), and fifteen are smaller alternative schools (grades 6-12). Three of these secondary schools are designated as academic high schools. Lowell High School, with an enrollment of 2,807, accepts only those students with close to straight-A averages during their second semester seventh and first semester eighth grades, and test scores on the Comprehensive Test of Basic Skills above the 97th percentile. Phillip Burton and Wallenberg High Schools have smaller, open enrollments; students who apply are selected by lottery, and students who are enrolled take college preparatory classes and are required to have four years of mathematics. At Burton, students who receive a grade of D or lower must repeat the course.

Of the district's total student population, approximately 48 percent are females and 52 percent are males. Eighty-five percent are minority students, as compared with a national average of 49 percent; of the remainder, 33 percent are Asian, 20 percent are black, 18 percent are Hispanic, 15 percent are white, 1 percent are American Indian and 13 percent are of other ethnic origin. Thirty-four percent of the student population considers English a second language; 28 percent are Limited English Proficiency (LEP) students. Eighteen percent of students in the district come from families that receive AFDC support, and 92 percent are eligible for federally funded lunch programs.

Total enrollment in the district (K-12) has declined over the past twenty years, from a high of 94,000 students in 1968 to a low of 57,000 students in 1982. Since 1985, enrollment has remained fairly constant at approximately 64,000 students.

Approximately 22,000 of these were enrolled in the district's high schools during 1987-88. Forty-eight percent of the high school population was female while 52 percent was male. Thirty-nine percent of students were Asian, 19 percent were black, 16 percent were white, 16 percent were Hispanic and 10 percent were from other ethnic groups. Thirty-three percent of the high school population considered English a second language. Approximately 18 percent of high school students' families receive AFDC support, and 92 percent are eligible for federally funded lunch programs.

Of the approximately 12,000 high school students enrolled in mathematics in the 1987-88 school year, 54 percent were Asian, 14 percent were white, 11 percent were Hispanic, 9 percent were black and approximately 13 percent were from other ethnic origins.

Scores on the Comprehensive Test of Basic Skills (CTBS) indicate that high school students in the SFUSD performed above the national average in mathematics, with a mean score in the 61-74 percentile range for grades 9 and 10 and in the 75-88 percentile range for grade 11. Reading scores, however, were within the 26-39 percentile range for grades 9 and 10 and in the 40-60 range for grade 11.

The SFUSD employed 1,300 high school teachers during 1987-88. Of these, 42 percent were women and 58 percent were men. Sixty-five percent were white, 13 percent were Asian, 11 percent were black, 7 percent were Hispanic, 1 percent were American Indian and 3 percent were from other ethnic groups. High school teachers' annual salaries ranged from $22,800 to $39,880 for the 1987-88 school year. Statewide, teachers in California earn an average annual salary of $33,000, making them the fifth highest paid teachers in the nation. It should be noted, however, that California has the second highest cost of living and the largest average class sizes in the nation. Approximately 25 percent of high school teachers in San Francisco are members of an active teachers' union. There are approximately 190 teachers of mathematics in the high schools. About 100 of these have a bachelor's degree with a mathematics major or minor. Data on the gender and ethnicity of mathematics teachers was unavailable.

The SFUSD budget for the 1987-88 school year was approximately $324 million, down approximately $22 million since 1985-86. Approximately 76 percent of the district's total revenues originated from California state funds, 15 percent came from local monies, 8 percent derived from federal sources, and about 1 percent came from county and other outside sources. The state Legislature recently voted to transfer $550 million in windfall tax revenues to K-12 classes statewide. In addition, taxpayers approved a $90 million bond issue to generate revenues for state schools; as yet, it is unclear to what extent this money will affect San Francisco schools.

District Superintendent Ramon Cortines, who has been in office for two years, faces the problems of a $10 million budget cut as well as the approximate $450 million needed to repair and refurbish schools and facilities. Moreover, cleanup of asbestos in SFUSD schools is estimated to cost $15 million in 1988.

The impact of budget cuts was evident as soon as school opened in September, 1987. Students were forced to share desks, classes were eliminated, middle schools cut sports programs and materials were in short supply. In addition, class sizes were increased and approximately 460 employees were laid off. In March of 1988, Superintendent Cortines recommended that 144 teachers and fifty-four administrators be laid off to save the district from bankruptcy, a proposal that was subsequently rejected by the school board.

In the face of such difficult decisions, Superintendent Cortines was praised by the San Francisco Board of Education for his strong leadership, his efforts to improve curriculum, and his policy of holding principals, teachers and staff accountable for improving the quality of education in their schools.

Policy Analysis for California Education, an educational policy research center, has predicted that 142,000 new children will enter California schools each year between 1987 and 1997, requiring about 80,000 new teachers and 1,500 new schools. Given the limited growth possibilities in San Francisco county, it is unclear how these increases will affect SFUSD schools, whether through overcrowding, busing to outside systems, or the construction of new schools.

In the beginning of the 1987-88 school year, Maria Santos was appointed by the school district as the Team Leader for the Mathematics Curriculum. Prior to assuming this position, Ms. Santos worked with the bilingual program and as a junior high school mathematics resource teacher. Her responsibilities include supervising the district's K-12 mathematics program.

Due at least in part to Ms. Santo's appointment, the district organized a number of in-services for mathematics teachers during the school year. After attending a collaborative reception at the Exploratorium to watch mathematics teachers demonstrate their exhibits, Ms. Santos decided to hold the district's annual in-service staff development day for mathematics and science teachers on January 29, 1988, at the Exploratorium. At this in-service, 215 K-12 teachers viewed demonstrations by teachers who have participated in the Exploratorium Summer Institutes. The district last year adopted a single algebra textbook (Merrill) to be used by all Algebra I teachers, and regional orientations on the new curriculum were conducted in September. On November 12, the school district and the San Francisco Mathematics Teachers Association sponsored a two-hour workshop for grades 7-12 teachers on problem solving in groups. In November, February and April, the district sponsored a series of workshops on quadratic functions and other algebraic topics presented by a consultant for the textbook publisher. A statistics institute, presented by a professor of mathematics from San Francisco State University, was sponsored by the district on three Saturdays in March. For their participation, teachers received a $150 stipend and one unit of credit from the extended education department at the university.

Other opportunities for continuing education in the Bay area include colloquiums, the Industry Initiatives for Science and Mathematics Education (IISME) eight-week summer program sponsored by the Lawrence Hall of Science, and sessions conducted by the Consortium for Excellence in Mathematics Education. Both the IISME and the Consortium are associated with the University of California at Berkeley. In addition, the California Mathematics Council sponsors a series of regional meetings; during 1987-88, these included the Northern Section meeting in Asilomor in December and the Wine Country Mathematics Conference in Santa Rosa in February.

Superintendent Cortines has defined as a district-wide goal the identification of a common curriculum in all high schools. Toward this end, the district adopted a single textbook to be used in all SFUSD Algebra I classes, beginning in the 1987-88 school year. During April and May, a Geometry Curriculum Development and Textbook Selection Committee met five times to select the geometry textbook to be used next year.

The state of California has mandated that, as of September, 1988, all teachers must be certified in the content area in which they teach. This new requirement will have a particularly severe impact on mathematics instruction in the district given that many of the teachers now in mathematics classrooms--especially general mathematics and Algebra I--do not have a major or minor in mathematics. Principals will be held responsible for ensuring that all teachers have become certified by passing the National Teachers Examination.

C. Development of the Collaborative

The Collaborative's Administration

The San Francisco Mathematics Collaborative continued to evolve during the 1987-88 school year. Effective July 1, the San Francisco Education Fund appointed Judith Massey-Morales as its collaborative manager, a position funded by the Walter S. Johnson Fund. As Director of Programs and Evaluation, Ms. Massey-Morales is responsible for overseeing the operations of all of the collaboratives (mathematics, science, and art) and other major projects supported by the Education Fund. A fourth collaborative for economics was convened, but because it is being operated by the SFUSD, the Fund and Ms. Massey-Morales play only adjunct roles; 70 percent of her time was allocated to addressing the needs of the collaboratives.

The new position assumed by Ms. Massey-Morales suggests a shift in the focus and mission of the Education Fund. Initially the Fund's efforts were largely devoted to acquiring and distributing mini-grants to support enrichment projects for teachers and their students. Since its inception, however, the Fund's primary focus has evolved from facilitating teachers' applications for and receipt of grant monies to providing a variety of opportunities for teachers to participate in professional activities. As the number of these projects increased, they demanded greater administrative attention; it became clear that activities such as raising matching funds, interacting with the school district, facilitating Steering Committee meetings, and preparing proposals needed to be coordinated and supported. In response to this need, the Education Fund appointed Ms. Massey-Morales, who had been with the Fund for six years. It is clear that the impetus and success of the collaborative movement has prompted the Education Fund to rethink its mission.

During the summer of 1987, the Education Fund initiated the process of hiring a new project coordinator for the mathematics collaborative. Since its inception in 1985, the collaborative had been directed by a mathematics teacher who was granted release time by the district for her collaborative work but who continued to teach part time. The new coordinator, who would be paid by the Education Fund, would be responsible for planning collaborative activities, meeting with its various committees, and networking with important local organizations. The Education Fund, concerned with the collaborative's continued development and stability, also established as a job requirement that the new coordinator be willing to agree to a three-year commitment to the position.

In hiring a new coordinator, the Education Fund considered whether or not the position should be filled by a teacher; it was clear that the original coordinator had found it difficult to split her time between the collaborative and the classroom. In addition, it was suggested that a coordinator who was accountable exclusively to the Education Fund--as opposed to one who was also a teacher and an employee of the school district--might find it easier to interact with the district administration on terms of professional equality.

In October, Dr. Robert Marcucci, who was teaching mathematics education courses at San Francisco State University on a half-time basis, was appointed as the collaborative coordinator. The mathematics department chair at SFSU viewed Dr. Marcucci's appointment to the collaborative as an opportunity for the university to connect with the teachers it is attempting to serve. As a result, the department granted Dr. Marcucci's request to split his time between teaching and collaborative administration. From the Education Fund's point of view, Dr. Marcucci brought to the position a firm knowledge of mathematics and teaching and a direct link to higher education. Finally, Dr. Marcucci assured the Fund that he was willing to serve as coordinator for the minimum three-year period.

Ms. Janice Toohey continued as the collaborative's Director of Development and Community Outreach during 1987-88. Her responsibilities included fundraising and coordination of activities sponsored by corporations and universities. Ms. Toohey's efforts to generate contributions for the collaborative had to be carefully coordinated with those of the Education Fund, which in 1986 had initiated a major endowment drive to raise $3 million; at the close of the 1987-88 school year, $2.4 million had been acquired. As a result of this ongoing endowment drive, Ms. Toohey needed Education Fund approval before she could contact local companies and businesses.

This coordination in fund-raising efforts illustrates a key aspect of the relationship between the Education Fund and the collaborative. Ms. Toohey, within certain constraints, was free to exert independent efforts to raise funds for the mathematics collaborative. She was not, however, invited to participate in meetings of the Education Fund in which its overall fund-raising strategy and activities were discussed and coordinated. As a result, Ms. Toohey was somewhat limited by her lack of knowledge about how her efforts to raise funds for the collaborative meshed into the overall strategies of the Education Fund. Despite these hurdles, Ms. Toohey has raised $50,000 for the collaborative since 1985. In addition, she provided continuity to the project during various personnel shifts and assumed the position of interim project coordinator for the summer of 1987. At other times, she helped coordinate activities and in 1987-88 played a major role in preparing the permanence proposal for the final phase of Ford Foundation funding.

Dr. Marcucci, Ms. Toohey, and a part-time administrative assistant work out of office space provided by the school district at the Parkside Center, where the offices of the district's curriculum staff are located. The collaborative has been allocated one section of a former classroom, which serves as office space for the district mathematics team leader, the district science team leader and the science collaborative coordinator. Jill Jefferis, a former mathematics teacher who has a master's degree in education, works half-time as an administrative assistant for the mathematics collaborative and half time for the science collaborative. In the past, the district had provided some clerical support but it was shared with several other employees at Parkside. Ms. Jefferis provides more consistent assistance to the collaborative administration by answering the telephone, preparing and distributing materials, and helping organize and coordinate activities.

The Steering Committee

The collaborative's governing committees, the Steering Committee and the Teacher Council, continued to make policies and program decisions for the collaborative. The Steering Committee, chaired by Henry Der, Executive Director of Chinese for

Affirmative Action, meets the first Thursday of each month. These meetings are attended by the collaborative administrators, and representatives of the Education Fund (executive director, director for program and evaluation, and a board member), the Exploratorium, three institutes of higher education, the school district, and the Teacher Council.

During the year, the Steering Committee discussed the organization and role of the Teacher Council; the organization of the Steering Committee; fund-raising efforts; the retraining of teachers; a lecture series; the permanence proposal to the Ford Foundation, including a five-year plan for the collaborative; mini-grants; and the general state of collaborative finances. At its January meeting, the committee clarified its position that collaborative funds should not be used to retrain crossover teachers; the collaborative's role was identified as assisting teachers in grant writing and working cooperatively with the district. At its June meeting, the committee discussed the budget included as part of the collaborative's proposal to the Ford Foundation. The committee resisted reducing the budget allocation for a project director, stressing the need for a project director's leadership and time. The committee also questioned a revision made by the Education Fund in an earlier version of the budget; the Fund had transferred $5,000 from travel grants to small grants. The Education Fund Board representative responded that all collaboratives were required to allocate some funds for small grants. A discussion of small grants ensued, and committee members reported that, to their knowledge, only four (15 percent) of the twenty-six mathematics teachers who had applied for small grants in the spring received them, compared with an overall approval rate of 40 percent. In fact, the Fund's Allocation Committee awarded seven of seventeen requests (41 percent) submitted by mathematics or computer teachers. The number of awards was restricted by the limited amount of funds available and several very good proposals went unfunded.

The Teacher Council

The Teacher Council consists of seven mathematics teachers who have been active in the collaborative and who expressed an interest in serving on the Council. In September, 1987, Council members included: Dan Bennett (International Studies), Sam Butscher (Wilson), Theresa Hernandez-Heinz (Mission), Susan Kelley (Lincoln), Steve Merlo (Galileo), Karen Morgan (Lincoln), and Wandaline Perelli (Lowell). In October, the Council elected Sam Butscher as chair. In November, Mike Serra joined the Council as a representative of the San Francisco Mathematics Teachers Association. Dr. Marcucci, collaborative coordinator and an ex-officio member of the Council, views it as a forum for teacher leadership and control; as a result, he looks to the Council for direction in addressing teachers' concerns. The Council met on the last Thursday of each month after several initial meetings at the beginning of the school year.

It is the Council's role to recommend direction and activities for the collaborative; monitor issues in the school district; network with other teachers; share information on mathematics issues; govern itself; report the needs and interests of teachers to the Steering Committee; facilitate follow-up seminars for collaborative participants; and involve teachers in collaborative activities. Topics discussed at Council meetings included program ideas such as a math fair, workshops, a district-wide mathematics conference, and receptions; Math A; interaction with the business world; the relationship between teachers and the district; crossover teachers; the NCTM Annual Meeting; the Exploratorium Summer Institutes; the NCTM Curriculum and Evaluation Standards; and teachers' projects. The Council allocated $400 each to ten teachers to support their attendance at the NCTM Annual Meeting in Chicago. These teachers presented a workshop in May to share their experiences and newly acquired knowledge with their colleagues. After hearing input from the Exploratorium staff, the Council also voted to allocate funds for the Summer Institute, and to structure the event so that it was shorter in duration but open to a greater number of participants.

In addition to its support of the governing committees, the collaborative administration worked to foster greater cooperation and interaction between the collaborative and the San Francisco Mathematics Teachers Association (SFMTA). SFMTA is an association of mathematics teachers funded by an annual $5 membership fee. The SFMTA, which meets twice annually, has been active in addressing school district policies that affect the teaching of mathematics. For example, the association conducted a study that determined that 30 percent of mathematics sections in the district were being taught by teachers without a mathematics major or minor. During the 1987-88 school year, Dr. Marcucci met with SFMTA representatives to discuss issues related to the teaching of mathematics in San Francisco public schools. Toward the end of the year, a group of elementary teachers formed their own association for the teaching of elementary mathematics, a development that suggests an increased level of interest in mathematics teaching within the district.

Major thrusts for the development of the collaborative during the 1987-88 school year included strengthening the relationship between the district and the collaborative, stabilizing collaborative administration, developing the Teacher Council into a coherent working group, and planning for a permanent structure for the collaborative. Efforts to strengthen the project's relationship with the district were initiated during the summer of 1987, with a meeting of Deputy Superintendent Linda Davis; Director of Curriculum Roger Tom; Education Fund Executive Director Gladys Thacher; Director of Programs and Evaluation Judith Massey-Morales; and Mark Driscoll of the Technical Assistance Project. Discussion covered district priorities, including Project ACCESS in the middle schools, equity, the collaborative coordinator's position, and curriculum revision.

Interaction between representatives of the collaborative and the school district continued throughout the school year. The new collaborative coordinator and the new mathematics curriculum team leader worked together in planning activities and in meeting with representatives from the SFMTA. Dr. Marcucci drew upon collaborative resources, for example, to solicit information from EDC on the retraining of teachers; he then provided this information to the district. He also met with a group of teachers preparing to take the National Teachers Examination to explain how passing the exam would affect their credentials. In addition, district representatives attended a number of Steering Committee meetings.

Plans to write the permanence proposal involved both the Steering Committee and the Teacher Council. A small subgroup of the Steering Committee met in January to generate ideas, which were then elaborated upon at the meeting of the full committee in February. Five goals, objectives for each, and methods for achieving those objectives were identified. The collaborative's goals are to:

1. Promote the professional and leadership development of mathematics teachers;
2. Increase the accessibility of mathematics to students;
3. Position the collaborative as a vehicle by which the Bay Area Community may invest in excellent mathematics teaching and through which an exchange between the community and the schools can be fostered;
4. Increase public awareness of the beauty and value of mathematics literacy; and
5. Develop a model for evaluation of the effectiveness of the collaborative effort on students in mathematics classrooms.

At subsequent meetings the Steering Committee addressed issues related to the budget and the SFEF Finance Committee's concerns about the cost of the collaborative over the next five years. Of particular importance were the stipends provided to teachers who attend collaborative events, the proportion of the budget to be allocated to administrative costs, and the use of collaborative funds for small grants.

The Teacher Council participation in the planning process involved generating program ideas and reviewing drafts of the five goals. The SFEF Board of Directors discussed the plan, reviewed the goals, and approved the budget. The Board also raised the issue of whether the mathematics collaborative was affecting student test scores, with some Board members questioning the viability of the collaborative if such results were not forthcoming. Other Board members questioned whether the SFEF could afford to fund a collaborative over the next five years. The final proposal submitted to the Ford Foundation was prepared by Ms. Toohey and Mr. Andrew Bundy, Director of Development for the SFEF.

Other committees with some relationship to the collaborative include the Education Fund's Program Development and Finance committees and the Tripartite Council. Any collaborative proposals that require funding must be approved by the Program Development Committee and the Finance Committee. The collaborative's coordinator and director of Development and Community Outreach also attend each of the Tripartite Council's monthly meetings. This networking group, composed of SFEF staff, and representatives from higher education and the schools, meets to keep the channels of communication open among their various institutions.

D. Project Activities

During the 1987-88 school year, the San Francisco Mathematics Collaborative sponsored a variety of activities that enabled teachers to establish networks with their peers and with other professionals, and to increase their awareness of the developing world of mathematics and its applications. A number of activities sponsored by the San Francisco Unified School District or by other Bay Area institutions also offered significant opportunities to area mathematics teachers. The collaborative supported these related activities by publicizing the events and, in some cases, by providing funds to allow teachers to participate.

Fall Reception

On November 9, 1987, the San Francisco Mathematics Collaborative sponsored a Fall Reception at the Exploratorium to honor eighteen mathematics teachers who had participated in the Exploratorium's independent study program or written successful mathematics grants. It was the first collaborative event to include middle and elementary school teachers.

In total, 135 teachers, business professionals, college staff, district administrators, and affiliates of the San Francisco Education Fund, as well as a member of the Board of Education, gathered for the evening, which was hosted by Chevron USA, Inc. and the Exploratorium. Speakers included representatives from the Exploratorium and Chevron USA, the Deputy Superintendent of Instruction from SFUSD, the collaborative's project director, and a Board member of the San Francisco Education Fund. Independent study projects that teachers had completed at the Exploratorium, as well as small-grant projects funded through the Education Fund were on display.

One teacher commented, "It was very interesting to see the lesson plans developed by the teachers. . . . " The on-site observer noted, "It fulfilled a need for sponsors and teachers to see the finished products of teachers who have been working on collaborative projects. Very well-organized event."

Lectures

Chevron Dinner/Lecture Series

During the 1987-88 school year, Chevron USA sponsored its third and final series of dinner lectures at the Seven Hills Conference Center at San Francisco State University. Five dinner lectures were scheduled over the course of the year, and many of the speakers addressed subjects included in the *California Mathematics Framework*. The events were designed to promote collegiality between mathematics teachers and representatives from business and industry. All SFUSD high school mathematics and middle school teachers, as well as elementary contact teachers, (those teacher identified by the district as the individual to contact in regard to mathematics within the school), were invited to attend.

The 1987-88 series of dinner lectures, like the two series that preceded it, was very popular. The teachers expressed disappointment that the three-year series has been concluded.

The first dinner lecture of the 1987-88 school year was held January 28 and featured Mr. Donald Kerr of Chevron USA, who discussed "Statistics: How It Helps the Business Economist." Approximately fifty high school, middle school and elementary teachers attended, as well as three Chevron executives and two representatives from universities. Mr. Kerr's lecture, which included real-world examples of elementary data analysis and statistical models, focused on how secondary mathematics provides a foundation for economic models. One teacher commented, "It was a nice change of pace from the classroom. Good presentation. Enjoyed meeting with the other teachers. Nice snapshot of business analysis. Good to see that high school math continues to be used in business. I might refer to this talk when my students ask me 'Are we ever going to use this?'"

The second dinner lecture, held March 2, 1988, featured Dr. Stanley Nel, a professor of mathematics at the University of San Francisco. Dr. Nel discussed "Geometry and Relativity" as explained through graphs. Approximately sixty people attended. One teacher commented, "I enjoyed it very much and meeting the other teachers over dinner is always enjoyable." Another commented, "The talk was very well prepared and articulated. He had a good interaction with the teachers and taught some important principles through geometry." The on-site observer commented, "The subject of relativity held great appeal for the audience and they thoroughly enjoyed the presentation. The graphs were very useful to see the concepts of geometry and relativity."

A dinner lecture on April 12, 1988, featured Ms. Ruth Cossey and Ms. Sherry Fraser of the EQUALS Program from the Lawrence Hall of Science. Their topic, "More Math EQUALS More Options," focused on the importance of employing new teaching strategies to increase the numbers of girls and minority students interested in mathematics. Forty-five teachers, three university representatives and two representatives from business and industry attended. One teacher commented, "I think this sort of lecture is superb! Not just math users, but math-using educators as speakers. They have a real understanding of presentation and relevance." Another added, "I am honestly learning new strategies, new exciting events in math teaching."

The fourth dinner lecture, which featured Professor Alan Schoenfeld of the University of California at Berkeley, was held May 5. Professor Schoenfeld discussed "Understanding and Teaching Mathematical Problem Solving," and compared the ways professors teach problem solving to their own problem-solving strategies, and how teachers teach as compared to how students learn. Fifty-seven teachers, as well as several representatives from Chevron USA and from San Francisco State University, attended. One teacher commented, "It was presented in a very understandable and humorous manner." Another added, "Professor Schoenfeld made a lot of us think about what's happening to students. There is a lot to think and to talk about afterwards." The on-site observer commented, "It was good. The speaker believes great changes can and should be made in teaching math. The audience as a whole was very stimulated and truly enjoyed the talk, especially the humor and the ideas presented."

The fifth and final dinner lecture, held June 14, 1988, featured Professor Jean Chan of Sonoma State University. Professor Chan, who spoke on "Packing Spheres," described applications in chemistry, physics and telecommunications. Fifty teachers and representatives of business and industry attended. Following the presentation, a Chevron USA spokesperson concluded the Dinner Lecture Series by expressing Chevron's satisfaction with its three-year program. One teacher commented, "The talk was great and as always I enjoyed the dinner meeting with other teachers." The on-site observer commented, "It was a very fine talk. . . . Naturally, there was a little bit of anxiety that this might be the last of a great series."

Geometry and Architecture Lecture

On December 14, the collaborative sponsored a slide show/lecture on geometry and architecture presented by Mr. William Blackwell of Bechtel International. Mr. Blackwell, author of *Geometry in Architecture*, is writing a mathematics supplement to his book and has developed a workshop for geometry teachers that connects the book's topics with current curriculum. Mr. Blackwell examined the relationships between basic geometric principles and such physical structures as furniture, buildings, towns, cities and other elements that comprise our "built environment."

Approximately fifty high school and middle school teachers and eleven representatives from the university and business communities, including several architects, attended the lecture, which was held at the Seven Hills Conference Center at San Francisco State University.

One teacher commented, "It was very worthwhile. The use of the diamond (a diagonal method for laying out streets) to show pedestrian distances was especially interesting." Another added, "The handout on the right triangle is directly applicable in my geometry and trigonometry classes. The book *Geometry in Architecture* is a beautiful edition and I enjoyed seeing it." Another teacher said, "I enjoyed speaking with the invited architects. That was a good idea."

Institutes

Exploratorium Teacher Institute and Independent Study

The collaborative offered its third Summer Institute at the Exploratorium July 27-August 28. The collaborative had budgeted funds to allow teachers to participate; all of the sixteen teachers who applied--nine new participants and seven who had attended the 1986 Summer Institute--were able to attend. The collaborative provided each of the teachers with a stipend of $1,000. The Exploratorium provided staff and meeting space.

The 1987 Summer Institute investigated the occurrences of mathematical shapes in nature, with the exhibits at the Exploratorium as focal points. By studying exhibits that spin, for example, teachers were able to identify new mathematical connections between exponentials and parabolas. Another exhibit in which light is projected through a network of strings provided further connections between sinusoidal waves and polynomials. Teachers also studied exponentials, catenaries, and conic sections as they occur spatially and temporally. These explorations helped them to identify links between trigonometric identities and the tuning of musical instruments.

Dr. Thomas Humphrey, faculty member of the Teacher Institute staff, observed that " . . . these connections really were discoveries in the sense that no one in the Institute, including the teacher, knew about them at the onset of the summer session."

Seven collaborative teachers participated in an independent study under Dr. Humphrey's direction. Each teacher investigated an area of individual concern, including pendulums and sinusoidal motion, number sequences of camera f-stops, natural parabolas, probability and right-angle reflection, and the trigonometry of bending light. As an outcome of their research efforts, these seven teachers developed worksheets and lesson plans that were circulated to teachers throughout the San Francisco Unified School District.

At the reception on November 9, seven teachers who had participated in the Institute or in the Independent Study made presentations to the 135 colleagues, student teachers, SFUSD administrators, business representatives and academics in attendance. In addition, the teachers who had created the new worksheets were honored for their contributions.

Exploratorium Follow-up Sessions to the 1987 Summer Institute

Teachers who participated in the 1987 Summer Institute were invited and encouraged to attend monthly follow-up sessions. The sessions were held on Saturday mornings during the 1987-88 school year. The workshops focused on a variety of exhibits and subjects. Each teacher received a stipend of $50 for attending each session. The stipends were funded through a local grant from the California Casualty Group.

Woodrow Wilson Foundation Geometry Institute

On August 3-7, 1987, the collaborative sponsored the Woodrow Wilson Foundation Geometry Institute at the Visitation Valley Middle School. All SFUSD geometry teachers, as well as geometry teachers from other districts in the San Francisco area, were invited. Approximately thirty geometry teachers attended, including fourteen SFUSD teachers; each participant received a stipend of $200 from the collaborative. Master teachers from high schools in Maryland, Indiana, Washington and Hawaii made presentations on the Geometric Supposer, learning strategies, inversion, fractals, spacial geometry, geometry with algebra, tiling, cycloids, geoboards, and the use of computers in teaching geometry.

Participants found the workshop valuable and worthwhile. One teacher said, "The Woodrow Wilson Foundation Geometry Workshop was fabulous. I learned many new conceptual approaches, did lots of hands-on activities and was brought up-to-date on new developments in high school geometry curriculum. I'm incorporating all of this into my classroom." Another commented, "The Institute was fabulous. We met daily from 9:00 to 5:00 and the time just flew by. There was also time for good exchange of ideas with all the participants." A third teacher said, "Participation of the teachers was encouraged. Teachers shared ideas of teaching. After the conference, I was really fired up. I enjoyed it tremendously. There was a lot of learning and exchange going on." Another added, "Excellent program. Very rewarding. Obtained valuable materials. I learned valuable information which I could use in class. I enjoyed the workshop and learned new ideas that could be used in the classroom."

Workshops

Proposal Writing Workshop

During the 1987-88 school year, the collaborative presented two proposal writing workshops at the San Francisco Education Fund for high school mathematics teachers interested in applying for small grants. Participants were encouraged to discuss their ideas with collaborative staff and grant recipients, as well as with other applicants, and to begin the writing process. Four teachers attended the first workshop on October 20, 1987, and fifteen teachers participated in a second workshop on February 20. The second session, which was conducted by Dr. Marcucci, allowed collaborative teachers to review one another's proposals and to offer suggestions for improvements.

Discrete Mathematics Workshops

Two workshops on topics in discrete mathematics were offered by the San Francisco Mathematics Collaborative during the 1987-88 school year. Enrollment initially was limited to twenty teachers for the first session and thirty for the second, with priority given to teachers who had not attended previous discrete math workshops. Participants each received a $25 stipend. The workshops, both of which were held at San Francisco State University, included a presentation and a reception at which teachers were able to interact with the presenter and with one another. Teachers were enrolled on a first-come, first-served basis.

Recursive Thinking. On November 30, 1987, Dr. Peg McPartland, a professor of mathematics at Golden Gate University, presented a workshop on recursive thinking. Dr. McPartland described recurrence relations (difference equations), how they are generated, and how to find their solutions. She examined applications in computer science, combinatorial mathematics, and population growth modeling. Thirty teachers attended.

In general, the teachers were pleased with the workshop, although some thought the speaker covered the material too quickly, especially for teachers who had not studied a lot of discrete mathematics. One teacher commented, "Very good speaker. Recursive thinking was a great topic. Outline was very well prepared. Interesting scope of problems." Another added, "Good practical information. Very good talk." A third said, "Went a little too fast. Difficult to keep up. I'd like to get the texts and read through the problem solving again. Very interesting problems."

Matrices. On March 22, 1988, a second group of thirty teachers heard Dr. David Meredith of the Department of Mathematics at San Francisco State University discuss "Matrices: What High School Students Should Know About Them." Dr. Meredith provided several examples of ways that discrete methods in linear algebra could be used to solve typical high school-level problems. Participants reported that the session was informational and worthwhile. One teacher commented, "Interesting. I will know some key concepts a little better to emphasize to my advanced algebra students." Another added, "Very well prepared. Detailed notes are appreciated."

NCTM Follow-Up Workshop

On May 2, 1988, the nine mathematics teachers who had attended the National Council of Teachers of Mathematics Conference in Chicago in April, 1988, presented a workshop to share what they had learned. All SFUSD high school mathematics teachers were invited to attend. Each of the nine teachers prepared handouts and made a 20-minute presentation. Approximately forty teachers attended the workshop, which was held at the Stern Grove Clubhouse.

Participants felt the workshop was a success. One teacher commented, "We should do more things like this, learning from other teachers." Another added, "It was tremendous. I gained many ideas I can use in the classroom." A third teacher said, "The dittos were especially useful. I brought back a lot of good information." The on-site observer said, "I thought it was a particularly successful event. The teachers were tremendously enthusiastic speakers. Interest in conference participation was increased. Teachers enjoyed the hands-on problem solving during the talks. It was a very 'collaborative' event."

Exploring Secondary Mathematics Through Science

In fall, 1987, the course "Exploring Secondary Mathematics Through Science" (referred to as Math 500) was offered for the first time at San Francisco State University. The course was developed as a result of Collaborative Steering Committee discussions about how to most effectively transfer the experiences of participants in the Exploratorium Institute into the classroom. Through the course, which was taught by Collaborative Project Director Bob Marcucci, ten SFUSD mathematics teachers and ten San Francisco undergraduates and prospective teachers investigated the relationships between secondary mathematics and scientific concepts. The class was designed to help participants develop techniques appropriate for the classroom and to make the teaching profession attractive to young college graduates. The collaborative paid the $90 tuition for each of the ten mathematics teachers. It is anticipated that the 3-unit course will be offered again in the fall of 1988.

Grants

Small Grant Program

During the 1987-88 school year, the San Francisco Education Fund and the San Francisco Mathematics Collaborative, with support from the General Electric Foundation, once again offered grant awards to teachers. Three types of grants of up to $750 each were offered for one-semester projects: Experimenter Awards, which are one-time awards to fill a need discovered after school has started and for which funding is not available; Disseminator Awards, which are renewal awards to allow successful small-grant recipients to document and disseminate their projects; and Adaptor Awards, which are granted to teachers who want to take a post-grant project and adapt it creatively to meet a school's particular needs. Proposals were accepted in the fall of 1987, and grants were awarded in the spring of 1988. In March, 1988, the selection process for grant awards of up to $2,500 for individuals and $5,000 for departments was initiated; the grants will be awarded in the fall of 1988.

The number and quality of grant proposals increased in 1987-88 as compared to those submitted during the past two years. Program Coordinator Barbara Ustanko of the San Francisco Education Fund staff said: "These proposals exemplified a new level of quality. The first proposals were not well researched regarding the goals and objectives of the Fund. Many teachers requested equipment for the sake of equipment alone. The most recent trend shows teachers developing programs for their classrooms, requesting materials and equipment as tools for the program. Their actual use in the classroom is well thought out. The teachers' ability to articulate their vision has improved. They are incorporating issues learned through the other collaborative programs and working in teams within their school mathematics department and across schools in their projected ideas."

A record twenty-three proposals were submitted by high school mathematics and computer teachers in 1987-88; ten were funded. In the spring alone, mathematics teachers submitted seventeen grant proposals, the largest number of proposals ever submitted by high school mathematics and computer teachers. Limited resources meant that only seven of the proposals could be funded. As a result, the Fund staff hopes to increase its fund-raising efforts so that more money can be allocated to grants in the future.

GTE Corporation's GIFT (Growth Initiatives for Teachers) Program

Mr. Dan Bennett, a mathematics teacher, and Mr. Thurston Williams, a science teacher at the International Studies Academy, received a grant from GTE Corporation's GIFT Program. Through this program, teachers tour the GTE laboratories and work with scientists to expand their awareness of telecommunications technology. During the summer of 1987, Mr. Bennett traveled to the GTE laboratories in Boston. The two teachers produced a handbook of resources and lesson plans for teaching global math and science, covering issues such as the environment, population, nuclear power, energy, and land use. The handbook is available free of charge to interested teachers. Mr. Bennett's participation in three Exploratorium Summer Institutes had prompted his interest in applications of mathematics to the sciences. This interest motivated Mr. Williams and Mr. Thurston to work together and to apply for GTE's program.

Tutorial Program

The collaborative received a grant from Pacific Gas & Electric Company to support a tutorial program at James Denman Middle School. Through the program, which was initiated by Ms. Linda Criner and Ms. Mary Lee McCune of the Educational Services Division of PG&E, San Francisco State University (SFSU) students work with mathematics teachers in the classroom tutoring students in small groups and learning classroom teaching skills. The university students earn $8 per hour, funded by PG&E, and are supervised by Collaborative Project Director Bob Marcucci and Carol Langbort of the SFSU Department of Elementary Education. The university students were in the classroom an average of three hours a week for fifteen weeks. The program is based on a highly successful effort in the San Diego public schools.

Curriculum Project with Uri Treisman

During 1987-88, SFUSD teachers Theresa Hernandez-Heinz, George Lai, and Sam Butscher worked with Professor Uri Treisman of the University of California at Berkeley to develop a plan for reducing the failure rate of black and Hispanic students in college preparatory mathematics classes. The group focused its efforts on the transition from middle to senior high schools. Through the program, high-risk students will be given the opportunity to attend summer school prior to entering ninth grade to take a course based on both Math A and first-year algebra courses. When they enter ninth grade, students who attended summer school will be clustered in classes taught by teachers who participated in the program. Ms. Hernandez-Heinz was granted a sabbatical from the school district during 1987-88 to develop the program. One outcome of her work with Professor Triesman and the other teachers was the submittal at the end of the summer, 1988, of a proposal to the National Science Foundation to help fund the program. The three teachers and Professor Triesman had all participated in collaborative activities prior to their efforts on the summer school project.

Industry Initiatives for Science and Math Education Summer Internships (IISME)

To familiarize teachers with jobs in science, mathematics, and engineering, IISME enables teachers to work for eight weeks during the summer in specially tailored jobs in manufacturing, analysis, testing, training, and research and development. It is hoped that their summer experiences will prompt teachers to encourage their students to study mathematics and science in preparation for future careers. The collaborative supports the program and offers publicity to inform area teachers about internship opportunities.

In 1986, two SFUSD teachers participated in the IISME Summer Internship Program. In 1987, the IISME project placed one San Francisco teacher at Pacific Gas & Electric. IISME received eighteen applications from San Francisco teachers for internships during the summer of 1988 and may accept five for placement.

Conferences

National Council for Teachers of Mathematics Conference

The San Francisco Mathematics Collaborative offered ten grants of $400 each to enable high school mathematics teachers to attend the NCTM annual meeting in Chicago, April 6-9. Flyers were distributed by the collaborative to all 190 high school mathematics teachers in the district. Grant recipients were required to attend a pre-conference meeting to coordinate their activities in Chicago and, after the conference, to share what they had learned with their colleagues. Ten teachers, representing a cross-section of San Francisco high schools, received grants to attend; at the last moment, one of the ten teachers could not participate. The nine who did go to Chicago indicated that the conference was a wonderful experience and expressed their feeling that they were representing both the SFUSD and the collaborative. Each teacher who attended NCTM participated in a follow-up workshop on May 2 to share the highlights of the conference with colleagues.

National Conference on Mathematics Reform and Teacher Professionalism

Two teachers from the San Francisco Mathematics Collaborative attended the Mathematics Reform and Teacher Professionalism conference at the North Carolina School of Science and Mathematics in Durham, North Carolina, on June 23-24. One of the teachers used money from a GTE grant to finance the trip, while the second teacher received funding from the collaborative. The conference was designed to inform and guide the broader mathematics community in its efforts to improve mathematics at the pre-college level. Sponsored by the Durham Mathematics Council with additional support from the North Carolina School of Science and Mathematics and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. Upon their return, the teachers discussed the conference at the Summer Exploratorium Institute and at a Teacher Council meeting.

Newsletter

The premier issue of the collaborative newsletter, *News by Degrees*, was published during the summer of 1987 and distributed to San Francisco mathematics teachers, the Education Fund Board and the school district administration. The newsletter was edited by Wandaline Perelli, former project director, and Janice Toohey, director of Development and Community Outreach. A Winter 1988 issue also was published, but in spring, 1988, the collaborative decided to discontinue its own newsletter and cooperate with the Math Teachers Association to produce its publication, *The Exponent*. *The Exponent*'s production and school distribution is supported by the SFUSD. The collaborative staff will write a column and calendar of activities and provide postage for mailing the newsletter to teachers' homes.

E. Observations

The San Francisco Mathematics Collaborative has been successful in developing activities that have had a significant impact on a number of teachers. The collaborative and the Education Fund continue to address the issue of the institutionalization of the collaborative.

Project Management

Extensive energy has been expended by the San Francisco Education Fund and by the collaborative administration to strengthen project management and to move the collaborative into a more stable position as it works toward permanence. This attention to collaborative management evolved, at least in part, in response to a communication from the Ford Foundation in June, 1987. In that memorandum, the Foundation articulated the conditions a site must meet in order to receive a permanence grant and offered its observations about the status of the San Francisco Mathematics Collaborative relative to those conditions. Efforts of the Education Fund have been helpful in a number of ways. Ms. Massey-Morales' designation as the Education Fund representative responsible for the collaboratives has established an explicit link between the SFMC and the Fund. Key to Ms. Massey-Morales' effectiveness is her knowledge of the Education Fund and her forthright approach to critical issues. She was influential in hiring a coordinator and in developing a more positive relationship with the school district.

Strengthening the collaborative management structure was also a necessary precursor to establishing the position of collaborative coordinator on a long-term basis and to providing this position with the necessary administrative assistance. Appointing a non-teacher as coordinator signified a shift in the Fund's thinking about the collaborative and its relationship to the school district. While a teacher served as the coordinator on a part-time basis the district wielded indirect influence over the project, and the teacher-coordinator struggled with the inherent conflict of providing leadership, on the one hand, and remaining within the parameters of district initiatives on the other. Its decision to hire from outside the district suggested that the Fund was making a conscious effort to remove the collaborative from under the aegis of district control--a move that required understanding from the district administration. The district agreed with the Fund's decision with the understanding that the coordinator would continue to work closely with the new mathematics team leader.

Dr. Marcucci's experience and training made him an ideal candidate for the position of coordinator. His term on the Steering Committee had made him very knowledgeable about the collaborative and familiar with many of its participating teachers. The support for his appointment expressed by San Francisco State University and Dr. Marcucci's department chair demonstrated the university's interest in the collaborative and in strengthening the collaborative's relationship with higher education. Finally, Dr. Marcucci's perspective on the coordinator's role helped to strengthen his position; he considered it the coordinator's responsibility, for example, to carry out the directives of the Teacher Council.

The Teacher Council has evolved over the year to become more empowered as a group. Council members have been appointed to fixed terms, leaders have emerged from the Council membership, and the Council has made significant decisions about the allocation of funds. In addition, the Council has retained a sense of continuity and an understanding of the collaborative's development by including among its members two of the project's former coordinators. The Council has yet to address its own expansion or replacement procedures for its membership.

It is important to note that the Education Fund provided money this year to allow the collaborative to hire a half-time administrative assistant who has been very helpful in performing such essential tasks as mailing notices to teachers and preparing for activities. This valuable assistance was not available to this extent prior to the Education Fund's decision this year to allocate the money to support the position.

The Director of Development and Community Outreach position has evolved since it was created and staffed by Ms. Toohey in the fall of 1986. At the outset, it was Ms. Toohey's responsibility to raise funds for the mathematics collaborative, to establish contacts with business and industry, and to inform the public about collaborative activities. In reality, Ms. Toohey occasionally assumed the position of a co-coordinator and helped to provide continuity in the management of the collaborative throughout the various changes in coordinator.

The lack of coordination between the fund-raising efforts of the mathematics collaborative and the Education Fund may have limited Ms. Toohey's efforts to some extent. The ongoing relationship between the collaborative and the Fund suggests that, should the project designate its own development director, the individual must maintain strong links to the host agency.

It appears that the status and the role of the San Francisco Mathematics Collaborative, as they relate both to the Education Fund and to the other collaboratives, have evolved and changed since the project's inception in 1985. Initially, all of the collaboratives functioned as appendages to the Education Fund, which served as a clearinghouse for them. As the Fund acquired additional collaboratives, it became apparent that centralization and coordination of such functions as fund raising was not only desirable but necessary. As a result, responsibility for development and fund raising shifted away from the individual collaboratives to the Education Fund, and the Education Fund Board began to discuss the cost of funding a collaborative three to five years in the future. In response to this transition in its responsibilities, the collaborative will eliminate the part-time position of Director of Development and Community Outreach in September, 1988. The duties of this position will be subsumed by a full-time position in the Education Fund that will oversee fund raising for all of the collaboratives.

Very real progress was made in 1987-88 toward increasing teachers' participation in the collaborative and developing a firmer relationship between the collaborative and the district. One reason for this was that the Teacher Council was stabilized to include a fixed group of teachers. The district administration's involvement in the collaborative's decision-making process has been enhanced by the presence of district representatives at Teacher Council and Steering Committee meetings. Prior to this year, very little information was exchanged between the collaborative and the district administration. These new efforts at cooperation, as well as the collaborative management's ongoing relationships with the mathematics team leader, have created an open channel of communication between the district and the project. Members of the SFUSD have begun to turn to the collaborative for help in addressing some of the pressing educational issues the district is facing. In a very real sense, representatives of the Education Fund and of the school district are learning to talk about collaboration.

Several management issues identified during preparation of the permanence proposal have yet to be resolved. One issue involves the concerns of some members of the Education Fund Board as to the importance of the collaborative approach and what a collaborative should be. Board members' comments that the effectiveness of the collaborative should be judged by student test scores suggest that they may not fully understand the nature or intent of the collaborative's focus on teachers. The disproportionally low number of mini-grants awarded in the spring to mathematics teachers as compared to teachers in other content areas raises the issue of the communication between the collaborative and the Appropriations Committee and the priority the Board is giving to the mathematics collaborative. This action was particularly disappointing to those in the mathematics collaborative who devoted both time and effort to significantly increase the number of mathematics teachers who applied for mini-grants. Board members' questions about whether the Education Fund can support the administrative structure needed to operate the mathematics collaborative once Ford funding is phased out suggest that the Board may be unsure about its commitment to the collaborative.

The mathematics collaborative has taken important steps toward strengthening its administrative structure, increasing the involvement of teachers in the decision-making process, and establishing open communication with the school district. Less evident is a coherent vision of the collaborative's future and a sense that the Education Fund Board understands and is committed to the collaborative concept.

Collaboration

Since the establishment of the collaborative in 1985, more than half of the 190 high school mathematics teachers in the San Francisco public schools have participated in at least one collaborative activity. More than a quarter of the teachers have been frequent participants and can be considered as the teacher core of the collaborative. One important product of collaboration has been the increased collegiality and networking evident among teachers. Prior to their collaborative involvement, teachers met infrequently with their district colleagues. Today, asked about the collaborative's contribution, many teachers describe the value and pleasure of getting to know other teachers, of, in one teacher's words, "meeting teachers at other schools and being able to ask them for ideas and share problems with them." Another teacher explained: "The collaborative has been instrumental in helping me meet other teachers of math in the district. Without its framework, I really would know very few other math teachers." For another teacher, who is the only instructor in his school teaching advanced mathematics, meeting a colleague who is teaching the same course in another school offered an opportunity to share ideas and problems.

A second form of collaboration has occurred between district mathematics teachers and the staff of the Exploratorium. The collaborative's ongoing relationship with the Exploratorium has been a mutually beneficial experience for both sides. Through continual interaction and discussion, both the collaborative administration and the Exploratorium staff have come to realize that teachers will benefit most from their Summer Institute experience if they participate for at least two successive summers. During their first summer, teachers become familiar with the Exploratorium and begin to discern the mathematical applications that can be derived from its exhibits. During their second summer in the program, teachers can begin to focus on a problem or application and are more prepared to translate their work into materials and concepts appropriate for classroom use.

In addition to new ideas and concepts that can be translated into lesson plans, the Exploratorium has contributed significantly to teachers' enthusiasm for and interest in mathematics. One teacher who had not participated in any collaborative activities, for example, was intrigued by his colleagues' descriptions of their experiences at the Summer Institute. He applied to attend, participated in the 1987 institute and as a result, began to give his students assignments that focused on particular exhibits at the Exploratorium.

Beyond the clear benefits to the collaborative, the Summer Institutes over the past four years have helped the Exploratorium staff to clarify its thinking and to recognize the value of interacting with mathematics teachers. One Exploratorium staff member remarked, "As the Teacher Institute has evolved over the years, mathematics teachers have had a great impact on the Exploratorium's understanding of mathematics in physics. Now as I look at the exhibits, I really 'see' mathematics in action."

What is most important, perhaps, is that the interaction between the Exploratorium and the collaborative has matured. Adjustments and concessions have been made by both sides as the collaborative's mathematics teachers and the Exploratorium's scientists have become acquainted and have come to understand how each can contribute best to their mutual benefit. Since its inception, the relationship has been founded on dialogue and free exchange--in short, on true collaboration.

The university community in San Francisco has been very active in the collaborative's development, as participants in its Steering Committee and as resources to its teachers. As committee members, the academicians participate in collaborative decision making and influence its direction. This input has been important in their efforts to position themselves as resources to teachers; in response to perceived collaborative interest or need, several representatives of local higher education institutions have presented workshops on such topics as discrete mathematics, problem solving, geometry and relativity, recursive thinking, matrices, packing spheres, and Math 500 focusing on hands-on practical approaches to mathematics instruction.

The collaboration relationship with local business and industry matured and flourished during the 1987-88 school year. The third and final series of Chevron

Dinner lectures was a great success and teachers' only concern was that the programs would be discontinued. An architect from Bechtel International who had written a book on geometry and architecture presented a lecture on the topic. A grant from the GTE corporation enabled two teachers to tour GTE laboratories; another Pacific Gas & Electric Company grant supported a tutorial program at a middle school. In addition, the collaborative has made efforts to develop a broader network of support in the business community by making initial contacts to other companies to solicit their participation in 1988-89.

Finally, the work of Professor Triesman and Ms. Hernandez-Heinz in developing a proposal to NSF is a new form of collaboration developed this year. The collaborative prompted these two educators, as well as the other teachers who became involved, to meet initially, which led them to discover that they shared a common interest. This is just one example of how seeds planted by the collaborative have generated activities and fostered cooperation well beyond the immediate scope of the project's own programs.

Professionalism

The collaborative has awakened in teachers a renewed sense of their own professionalism and intellectual creativity. This new awareness is evident in teachers' efforts to explore new mathematical concepts and ideas, in the strength and prominence of collegial networking, and in their efforts to bring enthusiasm and innovation into their classrooms. A physics teacher who is a frequent participant in collaborative activities reported that the collaborative "made me more conscious of the need to update my knowledge of current math methodology." A mathematics teacher reported, "(The collaborative) made me want to go to more conferences and learn more." Other teachers commented that the collaborative made them more aware of conferences and other organizations and events that relate to mathematics education.

Another indication that collaboration is inspiring teachers to explore new avenues of professional activity is the increased number of mini-grant proposals submitted during 1987-88. The collaborative has supported teachers' efforts by presenting proposal-writing workshops and encouraging teachers to take advantage of the grant programs offered by the Education Fund. The impact of these efforts is suggested by the comments of an Education Fund Board member, who observed that this year's proposals were superior in number and in quality as compared to those of earlier years. Unfortunately, relatively few of the proposals were funded.

Another manifestation of teachers' new awareness is their enhanced interest in participation on district committees. As collegiality increases and teachers throughout the district become better acquainted, they are more willing to volunteer to serve on district mathematics committees. The interaction of teachers at collaborative events also has contributed to their awareness of mathematics-related activities occurring in the district. This expanded access to information, combined with teachers' new-found sense of themselves as members of a network of support and collegiality, have fostered a willingness to get involved. In the past, committee membership has consisted largely of department heads and teachers who have been appointed to serve. During 1987-88, teachers began to initiate their own involvement by approaching administrators to volunteer.

Teachers have begun to make decisions about the collaborative's goals and direction, and they are feeling greater ownership of the project as a result. This has been particularly true of those who serve on the Teacher Council. Collaborative efforts to stabilize the Council by appointing a fixed group of teachers have fostered Council cohesion and have enabled leadership to emerge from within the group's membership. The Council made key decisions about sending teachers to professional meetings and allocating funds for several summer professional experiences.

Despite these very important successes, several fundamental issues have yet to be addressed. Mathematics teachers in the SFUSD are divided in their allegiances: many consider themselves collaborative members; others define themselves as members of SFMTA, the local teachers' union; only a few see themselves as belonging to both. This year a concerted effort was made to establish a formal relationship between the two organizations, a move that has greatly reduced the institutional barriers to teachers' participation in the collaborative.

This issue of allegiance is paramount to the professional lives of the teachers, whose attitudes and experiences will be determined, in large part, by the way in which their professional reference group is defined. If collaborative efforts and events are viewed as in conflict with the activities of other groups, the project's goal of reaching teachers in large enough numbers to achieve real change will be critically undermined.

A second barrier to be addressed in coming months involves the uneasy sense of mistrust that characterizes the relationship between mathematics teachers and the district administration. For budgetary reasons, the district dismissed a number of long-term substitute teachers, some of whom were very good mathematics teachers. In their places, administrators assigned teachers from other content areas. A SFMTA survey found that about a third of district mathematics classes were being taught by teachers without a major or minor in mathematics. This, combined with a new district initiative to establish a common curriculum in all high schools, and a district decision to cut the funding of a group of teachers who were going to develop materials for a Math B course, created a general skepticism about the administration and its attitude about the professionalism of its teachers. One mathematics teacher voiced a concern that the district was inhibiting, rather than fostering, professionalism. Another commented that the term "professional" is used only when the administration wanted teachers to do something extra without additional remuneration.

The collaborative and its activities have helped to generate initiative and networking among some teachers, but the issue of the collaborative's relationship to the district remains unresolved. Important steps were taken during the year that helped to foster communication between teachers and the district, particularly with the mathematics team leader. In addition, the Steering Committee discussed in January the importance of working cooperatively with the district to address problems associated with crossover teachers. Nonetheless, the climate of distrust remains, and has not been addressed effectively by the collaborative. This appears to be one issue that will need to be resolved if the collaborative is to continue to evolve into an organization that truly inspires in teachers a firm sense of their own professionalism.

Mathematics Focus

The San Francisco Mathematics Collaborative in the 1987-88 school year continued in its eclectic approach to mathematical content. One important determining factor was the interest of local resource people. As a result of their expertise and participation, activities focused on such topics as geometry and relativity, geometry and architecture, applied statistics, discrete mathematics, problem solving, packing spheres, and geometry. Most speakers represented higher education institutions in the area; one was a practicing architect. One dinner lecture focused on equity, a subject which drew an audience of teachers with less mathematics background than had other lectures. Finally, those teachers who participated in the Exploratorium Institute have enhanced their understanding of the application of mathematics in the sciences.

Collaborative activities are influencing teachers, the content they teach, and the ways they choose to teach it. Mini-grant proposals, for example, this year reflected many of the topics covered in collaborative activities. The mini-grants that were approved during the year addressed the application of mathematics in science and engineering, geometry in architecture, and the application of technology to the teaching of mathematics. The colloborative's impact also is evident in teachers' reports of changes in their classroom approaches. For example, after a teacher attended a class on matrices, he reduced his emphasis on the use of Cramer's rule and increased the amount of instructional time devoted to matrix manipulation. Another teacher reported that she was doing more with manipulatives in her geometry classes after attending the summer geometry Woodrow Wilson Institute. Other teachers have indicated that they are now using the Exploratorium as a resource by referring to particular exhibits most students had experienced and by giving students assignments involving specific exhibits.

The district sponsored more activities on mathematics during 1987-88 than it had in previous years. Many of these events were related to the district's decision to unify the curriculum across schools and have therefore focused on Algebra I topics. Other collaborative events were supported by the district and by mini-grants, including workshops on the *California Mathematics Framework* and on the development of materials for Math A and Math B, the first and second year courses designed for students who do not intend to go to college or who do not yet have the background for college preparatory courses. Despite the wide array of content-related presentations, however, a clear mathematics focus for the collaborative has not emerged; instead, presentation topics tend to be defined by the availability of local resource people and the interest of individual teachers. While this approach is valuable in its range and flexibility, it is deficient in that it cannot be expected to wield any significant impact on the district's curriculum and mathematics program. It can be hoped that the collaborative will be able to expand its core group of active members such that a significant percentage of teachers can contribute to a clear vision of mathematics in the district curriculum.

F. Next Steps

The San Francisco Mathematics Collaborative will undertake a four-month planning process to reorganize the collaborative, as well as to develop a Program Vision and Permanence Plan. The new San Francisco Mathematics Collaborative will be a project designed for and by mathematics teachers of all grade levels in the district. Its purpose will be to provide a permanent vehicle for district teachers, their colleagues, and the community-at-large to promote the advancement of quality mathematics education for all students. The project will continue to pursue this mission by reducing the professional, intellectual and collegial isolation of K-12 mathematics teachers while offering program activities that empower teachers to be the best they can be.

The two-part planning process will propose the development of a vision of the collaborative's goals, role and function in the support of excellent mathematics teaching and learning in the district, and the development of a financial plan that would support that vision and address the financial implications for all the collaborative partners, especially the district and SFEF.

Goals for the project include the creation of a "safehouse" in which teachers can freely engage in professional exchange; continued professional development opportunities to expand teachers' knowledge base and teaching approaches; collegial activities with other teachers and professionals; strong, active teacher leadership of the collaborative; renewed community investment in the public schools through the activities of the collaborative; and increased emphasis on teaching mathematics to girls, blacks and Hispanics. The collaborative's vision is one in which teachers are motivated, knowledgeable and accountable to their colleagues and to their students in their pursuit to become the best possible mathematics educators. The central function of the collaborative will be to provide a permanent vehicle for district teachers, their colleagues and the community to promote teacher empowerment and the advancement of quality mathematics education for all students.

The project's financial plan will be founded in a partnership involving the district, the Fund and other community members to ensure the permanence of the collaborative. The district will commit funds to support staff or program activities. The district also will add another Mathematics Core Curriculum Team Leader K-12. The Education Fund will support the collaborative, both in staff and programs, as well as supporting grants to mathematics teachers. Other organizations that plan to become involved include the Exploratorium; and the mathematics departments at San Francisco State University, the University of San Francisco, and City College of San Francisco.

The collaborative will increase the ongoing involvement of business and industry. A comprehensive organizational design and decision-making process will be developed by the Planning Group, together with a plan for ensuring teacher leadership. Financial management and project oversight will be clearly defined.

The Exploratorium will conduct a Summer Teacher Learning Institute, June 27-July 27 from 8:30 a.m.-12:30 p.m. for eight teachers who had not previously participated in a Summer Institute at the Exploratorium. During the 80-hour institute, teachers will explore mathematics as applied in Exploratorium exhibits. Teachers received letters explaining the program and application forms in May, 1988. Each teacher selected to participate will receive a $1,000 stipend and upper division science credit through San Francisco State University.

SUMMARY REPORT
TWIN CITIES URBAN MATHEMATICS COLLABORATIVE

by the

Urban Mathematics Collaborative Documentation Project

University of Wisconsin-Madison

PURPOSE OF THIS REPORT

This report summarizes the activities of the Twin Cities Urban Mathematics Collaborative during the 1987-88 school year. The report is intended to be both factual and interpretive. The interpretations have been made in light of the long-term goal of the Ford Foundation to increase the professional status of mathematics teachers in urban school districts and the way in which the activities of the collaborative during the past year have evolved in order to reach that goal.

The information presented in this report came from the following sources: the proposal submitted by the Twin Cities Mathematics Urban Collaborative to the Ford Foundation for the continued funding of the collaborative; documents provided by the project staff; monthly reports from the on-site observer; the meeting in New Orleans in October, 1987, of representatives of all of the projects; the directors' meeting held in San Diego in February, 1988; meetings held during the annual NCTM conference in Chicago in April, 1988; survey data provided by teachers; and three site visits by the staff of the Documentation Project.

TWIN CITIES URBAN MATHEMATICS COLLABORATIVE

A. Purpose

The purpose of the Twin Cities Urban Mathematics Collaborative, as expressed in the original proposal, is to "extend the sense of professionalism among secondary school mathematics teachers, provide for their further intellectual stimulation and renewal, and establish collegial and professional relationships among the teachers and the wider mathematical community of the Twin Cities." During the first and second years of funding, the collaborative worked towards these goals; in future years, the collaborative's efforts will be directed at refining its focus. This includes addressing issues in more sophisticated areas of intellectual and political involvement, extending the project's influence throughout the Twin Cities, and seeking avenues to ensure continuation of the collaborative project beyond the involvement of the Ford Foundation. Five specific steps have been identified to help the collaborative achieve its goals. They are:

1. involving teachers in activities that help them to exercise more responsibility for and control over their professional lives;

2. continuing to provide a broad range of mathematical activities that encourage ongoing participation in the collaborative;

3. expanding the base and scope of industrial involvement;

4. integrating groups and organizations involved in precollege mathematics education into the collaborative; and

5. increasing the visibility and the stature of the collaborative in the Twin Cities, specifically within the school districts.

B. Context

The Twin Cities Urban Mathematics Collaborative (TCUMC) is different from most UMC sites in that it encompasses two school districts in two cities, each with unique education policies, school boards, and strengths and weaknesses. The population of the Minneapolis/St. Paul area is approximately 620,000, down about 3 percent since the 1980 census. In 1988, the estimated population of Minneapolis was approximately 356,000, compared with 371,000 in 1980; the estimated population for St. Paul was approximately 265,000, compared with 270,000 in 1980.

Minneapolis Public Schools

During the 1987-88 school year, the Minneapolis Public Schools (MPS) served a student population of approximately 39,737. Enrollment for the 1988-89 school year is projected to increase to 40,316, a trend that is expected to continue until 1991, when enrollment is projected to reach 42,300. This would represent an increase of approximately 12 percent since 1983, with the greatest increases occurring at the elementary level. This population should increase by 25 percent, while the secondary population is expected to decrease by about 10 percent.

During 1986-87, 58 percent of students in Minneapolis public schools were white, 27 percent were black, 7 percent were Asian, 7 percent were American Indian, and 1 percent were Hispanic. Fifty-two percent of the total enrollment was male, and 48 percent was female. Thirty-one percent of pupils' families received AFDC and 41 percent were eligible for federally subsidized lunch programs. Six percent of the student population was considered of Limited English Proficiency (LEP).

Eight senior high schools serve the district's 12,000 students in grades 9-12. During 1986-87, 63 percent of high school students were white, 23 percent were black, 7 percent were Asian, 4 percent were American Indian and 2 percent were Hispanic. Enrollment decreased by about 2 percent since 1985-86, and was projected to decrease another 2 percent in 1987-88.

The dropout rate for MPS schools for 1986-87 was approximately 9.7 percent. The majority of dropouts (88 percent) were students in grades 10-12. Ninety-one percent of Minnesota high school seniors graduated in 1987, making it the only state in the nation with a graduation rate exceeding 90 percent.

Graduation requirements for Minneapolis schools include one full year of mathematics and one year of science in grades 10-12.

MPS employs 114 mathematics teachers. Forty-five, or 39 percent, are women, and sixty-nine, or 61 percent, are men. Three high school mathematics teachers are black, two are Asian, and one is Native American; the remainder are white. All hold at least a bachelor's degree, and two hold doctorates. State policy in Minnesota mandates that students may receive credit for a course only if the teacher is certified in that subject area. As a result, all MPS mathematics teachers in grades 7-12 are certified in mathematics. Since the twenty-one non-tenured mathematics teachers in MPS were cut in 1986-87, all high school mathematics teachers are tenured. Teacher salaries average $38,000 per year, and contracts are renewed every two years.

All MPS teachers belong to the Minneapolis Federation of Teachers (MFT), an active union that, among other local issues, participates in school board campaigns. This year, for example, the union contributed $20,000 to the 1987 school board race, which was hotly contested by both incumbents and challengers. Issues centered on desegregation and the current Minnesota policy of allowing parents to choose the schools in which their children are enrolled, as well as the restructuring of school board seats to eliminate at-large members and increase the number of members from seven to nine. Incumbents lost three of four seats to candidates supported by "The Quality Education Coalition" comprised of legislators, city council members, and parents. Voters overwhelmingly rejected the school board restructuring referendum.

Superintendent of Schools Richard Green resigned in March of 1988 to become Chancellor of the New York City schools. Dr. Robert Ferrera, former superintendent of schools in Grand Rapids, Michigan, will assume the position beginning in August. His record suggests that he supports stiffer graduation requirements, formulating district curriculum guidelines and developing specialty schools.

The MPS budget in 1987-88 totalled $164 million. Of this, approximately 47 percent came from state revenues, while most of the remainder came from local monies; only $400,000 came from federal reserves and $100,000 from other sources. Expenditures for the 1987-88 school year totalled approximately $168.5 million, resulting in a $4.5 million deficit. Projected expenditures for the 1988-89 school year are $178 million, but anticipated revenue reductions of $7.5 million may mean cuts in teaching staff as teacher salaries make up approximately 85 percent of the total expenditures.

In June of 1988, secondary schools in Minneapolis experienced a 17 percent cut in staff, when approximately 200 teaching positions were eliminated. Public outcry against these cuts may pressure the MPS to refill at least some of these positions for 1988-89.

St. Paul Public Schools

The St. Paul Public Schools (SPPS) district encompasses thirty-three elementary schools (grades K-6), eight junior high schools (grades 7-8) and six senior high schools (grades 9-12). In addition, the district includes one open school (grades K-12), two K-8 elementary schools, one evening high school, one alternative school (grades 7-12), and twelve pre-kindergarten schools. The SPPS serves a population of approximately 32,000 students (pre-kindergarten to grade 12).

Of the total SPPS student population, during 1987-88, 48 percent were female and 52 percent male. Sixty-two percent of students were white, 15 percent were black, 15 percent were Asian, 6 percent were Hispanic and 2 percent were American Indian. Eighteen percent of students have English as a second language. Forty-four percent of SPPS students are eligible for federally funded lunch programs. Demographic trends indicate a shift from the black population as the predominant minority group to Asian-Americans. Twenty-six percent of students in the city attend private schools.

Approximately 9,000 students attended SPPS high schools during the 1987-88 school year. Demographic data on ethnicity, gender breakdown, AFDC status, and other variables were unavailable. Thirty-eight percent of students were new to their schools in the fall of 1987.

Graduation requirements for SPPS students include one year of ninth grade math or Algebra, or one year of science. The dropout rate in 1987 was approximately 12 percent for grades 9-12. Students were identified as dropouts after their withdrawal from the district, or after their absence for more than fifteen consecutive days.

SPPS students in 1987 averaged in the 55 percentile on the ACT composite scale and in the 60th percentile on the ACT math scale. In addition, scores on the SRA Survey of Basic Skills indicate that approximately half of high school students in the SPPS score over the 50th percentile, thereby approximating national norms.

The SPPS employs 102 high school mathematics teachers. Of these, twenty-two (22 percent) are women and eighty (78 percent) are men. Only two are minorities. One is black, and no information is available pertaining to the ethnic heritage of the other minority teacher. All high school mathematics teachers have earned at least a bachelor's degree and more than 75 percent have earned at least a master's degree. As with Minneapolis teachers, all St. Paul teachers are certified to teach in their subject areas. The average number of in-service days for high school mathematics teachers in the SPPS is four days during the school year and four days prior to the academic year.

In 1987-88, SPPS high school teachers earned an average salary of approximately $31,400. Although the current teacher contract covers 1987-89, it was not approved until January, 1988. According to Minnesota law, teachers pay dues to their respective bargaining agent whether they are members of the union or not; hence, most SPPS teachers belong to the Minneapolis Federation of Teachers (MFT), the local active teachers' union. Ninety percent of high school mathematics teachers are tenured.

Dr. David Bennett has been superintendent of the SPPS district since 1984. By promoting elementary magnet programs, Dr. Bennett has generated a lot of excitement in the city over improved academic performance. It is still unclear what impact these programs will have on regular elementary curriculum.

Background

Although budget cuts have wielded negative effects on both school districts, they also have served as an impetus for the development of innovative programs sponsored in part by business, university and community funds. The Minnesota Mathematics Mobilization (M^3), for example, is an NSF-funded project designed to represent mathematical issues at all levels of education, industry and government. Further, a new school-business partnership, the St. Paul Compact, is considering whether it will sponsor business-community mentors, guaranteed scholarships for college, matched savings programs for college education, and cash incentives for top-rate attendance. In addition, Minnesota students are allowed to take college courses while they are still in high school rather than having to attend the university or other colleges. This program, which has affected about 6,000 students statewide and has resulted in university or college professors teaching courses in high school buildings, may save the district the expense of hiring full-time teachers for advanced mathematics courses.

C. Development of the Collaborative

During 1987-88, the Twin Cities Urban Mathematics Collaborative continued under the leadership of Project Director Harvey Keynes. Dr. Keynes was assisted by Ms. Sally Sloan, a teacher at Edison High School in Minneapolis, who assumed the position of part-time teacher coordinator, and Steve Watson, who facilitated the process of developing the permanence proposal. Mr. Watson was on a one-year Bush Fellowship working in the Special Projects Office of the Mathematics Department at the University of Minnesota while taking some classes. He had been a secondary history teacher and was on leave from a state organization that oversees the federal title programs. The on-site observer for the collaborative is Gerry Sell, who also co-edits the collaborative newsletter and serves as project historian.

The Twin Cities Urban Mathematics Collaborative's target audience consists of the nearly 260 secondary certified mathematics teachers working in public, private, and parochial schools within the geographic boundaries of the cities of St. Paul and Minneapolis. Its members also include approximately fifty people from business, higher education and others who are involved or interested in mathematics and mathematics education.

The collaborative is governed by a Steering Committee that makes policy decisions and a Teacher Advisory Committee that generates program ideas and acts as an advocate for teachers. During the school year, one of the collaborative's top priorities was its plan for permanence and a blue ribbon permanence committee of seven members was appointed to direct this effort. A fourth group instrumental in the collaborative organization consists of Building Representatives. Composed of one teacher representative from each of the junior and senior high schools in the two districts, this group was formed to build teacher self-governance into the collaborative structure.

Steering Committee

During 1987-88 the Steering Committee was composed of thirteen voting members and three ex-officio members. Voting members included five representatives of higher education, two of high technology industries, the mathematics supervisor from each of the two districts, one school district administrator, and three teachers. Ex-officio members included the teacher coordinator, the facilitator for the Permanence Committee, and the on-site observer. The group met four times during the school year. Three of the meetings were held from 4:30 to 6:30 PM Wednesday afternoon at Vincent Hall on the University of Minnesota campus. The fourth, a dinner meeting in January, was held from 6:15 to 8:00 PM. Attendance at each of these meetings ranged from ten to thirteen members. Topics included the permanence proposal, activities for the school year and the summer, and other related activities, such as those sponsored by the Minnesota Mathematics Mobilization and the Minnesota Mini-grant Program. The committee voted to send a letter to the two school districts requesting release time for mathematics teachers to attend the NCTM Regional Meeting in Minneapolis in November, to allocate funds to send eight teachers to an M^3 Quantitative Literacy Forum, and to allocate funds to help support the reception for Dr. Cockcroft, a mathematics reformer from England. At its March meeting, the Steering Committee voted to endorse the Permanence Committee's report after modifications had been made. In May, the Steering Committee met with the Teacher Advisory Committee to discuss the details of the permanence proposal, including the administrative goals, duties of the executive director, structure for the Building Representatives, and means for reducing costs. General consensus was reached on all of these issues.

Teacher Advisory Committee

The Teacher Advisory Committee in 1986-87 consisted of five teachers, the project director, Dr. Wayne Roberts of the Steering Committee, and the teacher coordinator. The project historian and Permanence Committee facilitator were ex-officio members. At the beginning of the 1987-88 school year, three of the teacher members, who had served on the committee from its inception, submitted their resignations because of their desire to spend their time in other ways. The collaborative's September newsletter announced the openings and requested that teachers interested in serving on the committee indicate their interest by contacting the project director. Two teachers expressed an interest and joined the committee at its January meeting. By the beginning of March, the third teacher slot had been filled. The Teacher Advisory Committee generally met the Mondays prior to the Steering Committee's Wednesday meetings. The two groups shared very similar agendas, with discussion at TAC meetings often viewed as input to the Steering Committee. The TAC met three times during the year. In May, the few TAC members who could attend met with the Steering Committee. In addition to topics outlined in the Steering Committee's agenda, TAC members discussed their relationship to the Building Representatives. At its March meeting, six teachers, Mr. Watson, and Ms. Sell reviewed the Permanence Committee's recommendations and raised specific issues, including the status of the newsletter editor, the several steps that must be taken towards permanence, and whether the length of service for policy board members should be limited to two consecutive terms.

Building Representatives

The Building Representatives met for the first time on September 22, 1987. In attendance were one mathematics teacher from each junior and senior high school in the two school districts (a total of twenty-eight schools) and from five private and parochial schools. In addition, a Steering Committee teacher joined the group, increasing its total membership to thirty-four teachers plus the teacher coordinator and project historian. Teacher representatives in Minneapolis were identified by the collaborative's teacher coordinator, in St. Paul by a teacher from the Teacher Advisory Council, and in the private and parochial schools by the project historian. These teachers were then asked whether they were interested in serving as members of the Building Representatives group, or whether they knew of a teacher from their building who would be interested. In almost all cases, the teacher who was approached initially agreed to participate. Each building representative received a stipend of $100.

Teachers from twenty-seven schools attended the first meeting. The group's goals included the enhancement of:

- communication among schools.
- communication between schools and the various advisory groups of the collaborative.
- communication between TCUMC and the schools.
- communication with the mathematics community and the public.

In addition, the group agreed that its focus for 1987-88 would be the general mathematics curriculum, and that the meeting should be devoted to a discussion of this topic. As one teacher commented, "Looks like we all have the same problems--general math always is an issue--never solved but always present." In addition, the group discussed ways to solicit more information about existing summer corporate internships, and raised some issues about mathematics currently taught in Twin City secondary schools and its relevance to the business world. Finally, the group decided to invite representatives from local colleges and universities to a future meeting to discuss concerns about the curriculum. A report of the meeting was printed and shared with teachers at all of the collaborative schools.

Four additional meetings were held during the school year, with twenty-six to thirty teachers in attendance at each session. At the November 18 meeting the group elected one of its members to serve on the Permanence Committee. It voted to recommend that eight teachers receive financial support to attend the M^3 Quantitative Literacy Forum, rather than the four that had been suggested by the Steering Committee. Summer activities that received the most verbal support from the group were the Exeter Computer Workshop and a Uri Treisman workshop in Berkeley, California, on the issue of minority students' participation and achievement in mathematics.

On January 13, 1988, twelve professors from local colleges and universities met with the Building Representatives and discussed their programs with the teachers. One of the professors expressed his enthusiasm: "I was so pleased to be invited. This is exactly the group we need to reach if we are going to improve standards at the community colleges." As a result of this interaction, two of the professors offered to visit several schools to talk to students about careers in mathematics, about college requirements in mathematics, and about women and mathematics.

At the group's April 21 meeting, Ross Taylor, mathematics supervisor from the Minneapolis school district, discussed grant writing.

Group members also voted to send two Minneapolis teachers to the Mathematics Reform and Teacher Professionalism conference in Durham, North Carolina. This decision marked a departure from earlier practices, in which the group had consistently chosen a representative number of teachers from each city for special events or awards.

The final Building Representatives meeting of the year was held May 18. This event was primarily an end-of-year social event, but extensive discussion occurred about the group's plans for next year. The on-site observer reported that the social was one of the best things that the TCUMC did during the year and that teachers became very enthusiastic about the collaborative events. Another important outcome was the networking that occurred among the representatives.

Permanence Committee

The TCUMC channeled much of its energy and effort during the past year into defining its permanent structure. A Permanence Committee consisting of seven members and two ex-officio members was formed. Initially the Steering Committee specified that the membership of the Permanence Committee should include three representatives of the Steering Committee (one from business, one from higher education, and one teacher), two from the Teacher Advisory Committee, one from the Building Representatives group, and one from a small college. Because some participants fell into more than one category, the desired range of representation was achieved with only seven committee members. The final committee of seven included one representative from the University of Minnesota, one from Carlton College, two teachers, one mathematics supervisor, one representative of business, and one from a community agency. Five of the members were from the Steering Committee, one from the Building Representatives, and one from the Minnesota Alliance for Science. Steve Watson served as facilitator for the group and was considered an ex-officio member, as was the on-site observer. In addition, the case study ethnographer for the documentation project attended most of the meetings.

Under its charge from the Steering Committee, the Permanence Committee was to prepare guidelines for a proposal that would be completed by March 1, 1988. At its first meeting on December 8, the committee reviewed the collaborative's current structure and activities. Nine types of activities were identified and then ranked by cost (high, moderate, or low) and management requirements (high, moderate, or low). It was estimated that at least half of the project's 260 eligible teachers had participated in at least one activity. Committee members agreed that a survey should be sent to TCUMC members in the next newsletter asking them to rank the collaborative activities and to identify those that should be continued, as well as to suggest new events that should be offered. Mr. Watson revised drafts of a proposal for each of the group's five meetings during the year.

Eleven people attended the Committee's second meeting on January 11, including Mark Driscoll from EDC. The meeting was conducted formally, with the minutes from the previous meeting approved and a set agenda followed. Discussion focused largely on collaborative activities, based in part on the sixty-four surveys that were returned by fifty-one teachers, four business and industry people, eight higher education teachers, and one mathematics supervisor. The perceived value of each activity was discussed independent of its cost and administration requirements. All of the activities were rated as valuable, but four received this rating without reservation: the Twin City Math Society, Building Representatives, the newsletter, and seminar sponsorship. The discussion of the Teacher Advisory Committee and the Steering Committee was delayed until governance and structure of the collaborative could be considered at another meeting.

Nine committee members attended the third meeting held January 25. They spent the hours browsing through the guidelines from the Ford Foundation for renewing the grant, as well as a draft proposal prepared by Mr. Watson. Of particular note was the stipulation that the renewal grant could be issued only to the existing grantee, in this case, the University of Minnesota. This restriction had implications for the committee as it began to investigate other host agencies. Another issue centered around a stipulation about "inner city" students. The group wanted clarification from the Ford Foundation as to whether the proposal could include an expansion of the collaborative to involve suburban and statewide school districts. The Ford Foundation said this would be suitable if it was necessary for collaborative permanence. Finally, the group agreed that a policy-making body was necessary.

Eight committee members attended the fourth meeting, held February 1, to discuss the administration and governance of the collaborative. The group agreed that, by 1992, the collaborative could be housed in a liberal arts college and administrated by a permanent TCUMC Policy Board. Possible funding sources also were discussed.

Seven members attended the fifth and final meeting of the Permanence Committee on February 22. Mr. Watkins presented a revised draft of the proposal to the committee, and discussion centered around details in the report. The committee also clarified the responsibilities of the newsletter editor; it was agreed that it should be a voluntary unpaid position responsible for preparing, publishing, and mailing the newsletter. One member recommended that a standing committee for long-range planning and programs be proposed as the governing body. The committee then unanimously approved its recommendations and submitted them to the Steering and Teacher Advisory committees. These committees reviewed the proposal at their March meetings and made some minor editorial changes. The April newsletter reported that the Permanence Committee had recommended that the TAC and Steering committees be replaced by a Board of Directors, and that the major collaborative activities be continued but that costs be cut by filling nearly all of the currently paid positions with unpaid volunteers.

The Minnesota Mathematics Mobilization (M^3), a statewide consortium of educators and others interested in mathematics education, provided many professional opportunities for collaborative teachers. The consortium operates under the co-directorship of Professor Harvey Keynes of the University of Minnesota, and Professor Lynn Steen of St. Olaf College,with the assistance of project coordinator Martha Wallace. M^3's organizational structure also includes a Steering Committee comprised of representatives of business, industry, higher education, and the schools. M^3 is supported by a grant from the National Science Foundation. It publishes a newsletter five times a year and sponsors such events as the Quantitative Literacy Forum, a conference on the NCTM Curriculum and Evaluation Standards, and other workshops.

D. Project Activities

During the 1987-88 school year, the Twin Cities Urban Mathematics Collaborative sponsored a wide variety of activities for mathematics teachers designed to enhance professionalism and to create networks among teachers and representatives of business and higher education. The collaborative also promoted and provided support to teachers to allow them to participate in activities offered by other local organizations.

TCMS Dinner Meetings

When the collaborative was established in 1985, the Twin Cities Mathematics Society (TCMS), initially called the Twin Cities Pre-College Mathematics Society, was formed to organize collaborative functions that would facilitate professional and social contact between mathematics teachers and university and industrial mathematicians.

Each year, the society has sponsored a series of successful dinner meetings for collaborative teachers and members of the larger mathematics community. Recognizing that the Ford Foundation grant will be available for only one more year, the Teacher Advisory Committee recommended that in 1987-88 the membership of the society be expanded to include teachers outside the collaborative's geographic boundaries in Minneapolis and St. Paul. It is hoped that this expansion will lead to an independent and self-supporting society.

In the past, society dinners had been offered free of charge. In 1987-88, however, collaborative members paid $5.00, which was half the cost of the dinner, while non-collaborative teachers paid the full $10.00 cost.

Three collaborative members, including a representative from Macalester College, met in August to plan the first TCMS dinner meeting. Four collaborative members, including the three who had attended the original meeting, met in December to organize the remainder of the series.

The first TCMS Dinner Meeting for the 1987-88 academic year was held September 30, 1987, at Macalester College. Professor Lawrence Markus of the University of Minnesota spoke on the topic, "Shock, Horror, Mathematics!" More than sixty people attended, including one representative from the business community and seven from post-secondary institutions. The high teacher attendance was attributed to the Building Representatives' promotion of the event.

In general, reactions to the evening were extremely favorable. On an evaluation form returned by forty-nine participants, forty-three rated the presentation either a 4 or 5 on a scale of 1 (poor) to 5 (excellent), and of forty-seven responses, forty rated the entire evening as either a 4 or a 5. One teacher commented, "This was a good overall program--a good evening." Another said, "We need more time to talk. Coming to the dinners gives me a chance to see people I don't see. This is the highlight."

The second TCMS Dinner Meeting was held January 13, 1988, in the Gourmet Dining Room of the Minneapolis Technical Institute. Professor George Sell of the University of Minnesota spoke on "The Mad Dogs of Calais," describing several famous problems in differential equations that remain unsolved.

Seventy people attended the dinner meeting, including eleven representatives from the university community and five from business and industry. This increased attendance was attributed to a variety of factors, including the fact that invitations were sent separately from the newsletter; that Wayne Roberts, a member of the collaborative Steering Committee and a professor of mathematics at Macalester College, sent a memo to mathematicians in industry to encourage their attendance; and that participants expected an excellent dinner prepared by students in the chef program.

Overall, the reaction to the evening was positive. One teacher said, "I always enjoy the opportunity to spend time with friends with common interests. We can talk about school and math and no one complains." Another added, "Great, except it got too late. Good presenter and overheads and a 'neat' title, but it was over my head." There was some concern that the teachers did not take advantage of the opportunity to interact with the mathematicians from other sectors who attended. An actuary commented, "The advertising appealed to people from industry to attend and support these meetings. I introduced myself and my affiliation to a few people but no one followed with anything but small talk."

The third dinner meeting was held March 1, 1988, at the Earle Brown Conference Center in St. Paul. More than seventy people attended, including five from universities. Ms. Marlys Henke and Mr. Larry Luck, both TCMS teachers, spoke on "Food, Fysics, Functions and other Fantasies." The collaborative had funded Ms. Henke and Mr. Luck's attendance at an NCSSM Summer Institute on curriculum reform in school mathematics, and they presented an overview of the Institute, focusing on some ideas useful in grades 7-11 and in pre-calculus. Their presentation previewed the summer workshop they offered in June, 1988.

While some attendees felt that the event was too long and that the site was inconvenient and ill-suited to a dinner meeting, others seemed to feel that the evening was very beneficial. One teacher commented, "As a teacher of analysis, I thought this was great." Another said, "Excellent and provocative." A third teacher commented, "Extremely interesting; nice job." Another added, "Interesting information, but this was too long for tired teachers."

The fourth and final TCMS Dinner Meeting of the 1987-88 academic year was held April 21, 1988, at the Campus Club of the University of Minnesota. William Boulger, a teacher at St. Paul Academy, spoke on the topic, "Fibonacci Numbers and the Pythagorean Theorem." Mr. Boulger participated in the 1987 Summer Institute and his presentation was based in part on work he had initiated there.

More than sixty-five people attended, including teachers and representatives from businesses and universities. Their response to the evening was overwhelmingly favorable. Of the fifty attendees who returned an evaluation form, forty-nine rated Mr. Boulger's presentation as "excellent." One teacher said, "This was the best dinner I've been to. Thank you." Another commented, "I've enjoyed every one of these. I hope this can continue in the future." Another added, "Excellent program and very well done."

1987 Summer Institute

An important component of the collaborative's overall efforts during the year was a Summer Institute from June 19-July 10, 1987. Classes met daily from 9 a.m. to 1 p.m. on the University of Minnesota campus. The program, which focused on a problem-solving approach to number theory, was taught by Professor Wayne Roberts of Macalester College. A principal goal of the Twin Cities collaborative--and therefore of the Summer Institute--is to help secondary teachers view themselves as part of the larger mathematical community. The Institute was designed to give teachers an opportunity to "indulge themselves as mathematicians, working on topics of genuine mathematical substance" that could be used to enrich virtually every subject in the secondary mathematics curriculum.

The Institute consisted of three components. First, a standard lecture format was used to cover topics in prime numbers, modular arithmetic, integer representation, rational and irrational numbers, solutions to linear equations with integral solutions, and the theorems of Fermat and Wilson. The second component drew upon number theory to solve problems, emphasizing fact teaching via problem solving. Finally, some time was devoted to class discussion of outside reading assignments, an activity which helped to place the subject of number theory in its larger mathematical context.

Although the Institute's focus was oriented toward junior high and middle school teachers, all collaborative teachers were encouraged to apply for the twenty available spaces, with priority given to teachers who had participated in previous collaborative or NSF Summer Institutes.

Of the twenty teachers who attended, thirteen had participated in the 1986 Summer Institute, two had participated in the 1985 Summer Institute, one had participated in the 1986 NSF Institute and one had participated in both the 1985 Summer Institute and the 1986 NSF Institute. Eight taught in St. Paul public schools, eight in Minneapolis public schools, two in local parochial schools and two in private schools. Eight of the participants were senior high teachers and the remaining twelve taught junior high. Each of the teachers received a stipend of $600 and $15 per week for transportation, as well as four mathematics credits from the Extension Division of the University of Minnesota.

As in previous years, the Institute was conducted separately from, but concurrently with, the NSF Teacher Renewal Institute, and Summer Institute participants were invited to attend NSF Institute events during the week prior to the Summer Institute.

While reactions to a midpoint evaluation of the Summer Institute varied as to whether the Institute was meeting the participants' expectations, an evaluation conducted at the end of the Institute indicated that it would have a direct impact on the participants' teaching methods and styles. Seven participants indicated they would include more problem-solving activities, three said they would include more group work, and five said they would set aside more time to enjoy the "beauty of math." None of the participants felt there would be "no change" in his or her teaching.

Some of the participants indicated that the 1987 Institute did not meet their needs to the same degree that the extremely successful 1986 Institute had. This sense of dissatisfaction was attributed to the enrollment of both junior and senior high school teachers this year. One teacher commented, "There is a definite break between the junior and senior high school teachers. Their stuff is not relevant. . . . We also need small group time in this class as we had last year." Another said, "Having junior and senior high school people in this class causes problems. Senior high teachers can easily do problems junior high people forgot about years ago." In general, however, participants found the Institute to be a very worthwhile experience. In identifying its strengths, teachers most often cited "being with other teachers" and "the instructor, Wayne Roberts." In commenting on the Institute as a whole, one teacher said, "I think I'll be a better teacher. I've begun to think of myself as a mathematician." Another commented, "Programs like the Ford [UMC Project] are so valuable to junior high teachers. Math teaching in the United States can get better through this type of program."

1987 Mini-Institute on Chaotic Dynamics and Fractals

As part of its mathematics project, NSF sponsored a Saturday mini-workshop on January 30, 1988. Presented by Professor Robert Devaney of Boston University, the workshop focused on innovative materials that have been developed to introduce high school students to computer graphics and chaotic dynamics. Four of the twenty participants were collaborative teachers; two were NSF Institute participants, and two were Summer Institute participants who were provided a special opportunity to attend. Workshop teachers received draft versions of a high school text written by Devaney for field testing during the 1987-88 school year and participated in an academic year follow-up. Dr. Devaney felt that the participants' contributions were of very high quality and reported that the classroom materials developed by one of the collaborative teachers were "an impressive piece of work."

Academic Year Seminars

As in the previous two years, a series of four Academic Year Seminars was held as a follow-up to the 1987 Summer Institute and the 1987 NSF Teacher Renewal Institute. Meetings were scheduled Friday, November 20; Saturday, January 30; Wednesday, March 2; and Saturday, April 23. At each seminar, individual classes met for about two hours, followed by a short general meeting. The Saturday seminars, which were scheduled to enable out-of-state NSF participants to attend, also included a general lecture and a dinner. All collaborative members, even those who did not participate in either of the Institutes, were invited to the lectures.

The first Academic Year Seminar of 1987-88 was held at the University of Minnesota on November 20, 1987, in conjunction with an Institute of Technology Mathematics and Science Articulation Conference that the collaborative had promoted. The IT conference was designed to provide teachers with a more thorough understanding of the Institute and its programs, so that they could better advise their students in career and college choices.

The general session of the IT conference ran from 11:30 a.m. to 2:15 p.m. From 2:15 to 4:00 p.m., small-group sessions were held on mathematics, physics and chemistry. Class meetings for the Academic Year Seminar were scheduled from 3:10-5:00 p.m., followed by a general meeting from 5:00-5:30. In some cases, participants in the Academic Year Seminar also attended the IT conference sessions.

Eleven collaborative teachers who had participated in the Summer Institute attended the first Academic Year Seminar, at which Wayne Roberts led a discussion of the NCTM *Standards*. Teachers appeared to be very interested in the discussion and were somewhat reluctant to end the discussion and return to issues of number theory.

On Saturday, January 30, 1988, eight of the twenty teachers who had participated in the 1987 Summer Institute attended the second Academic Year Seminar, which was held at the University of Minnesota. Under the guidance of Dr. Roberts, the class focused on probability, as well as on developing appropriate problem-solving materials for junior and senior high schools. At 4:15, following the general meeting, Professor Robert Devaney of Boston University reported on the outcomes of the Chaotic Dynamics Mini-Institute Program. As noted earlier, Dr. Devaney is writing a text for high school students; teachers who participated in the summer mini-institute piloted these materials. Dr. Devaney described the classroom mathematics that teachers had developed as a result of their participation in the program, and reported on the outstanding set of lessons that had been developed by one of the collaborative teachers. The meeting ended with a complimentary dinner funded by NSF.

On March 2, 1988, seven teachers from the Summer Institute participated in the third Academic Year Seminar. The seminar, which was led by a visiting faculty member from a local college, focused on statistics. Of the seven attendees, all but one were junior high teachers. It was hypothesized that the low attendance was due to teachers' lack of interest in receiving the academic credits granted for participating in three of the four seminars. Participants did feel that the seminar was worthwhile.

On April 23, 1988, the fourth and final Academic Year Seminar for participants of the 1987 Summer Institute and 1987 NSF Teacher Renewal Institute was held at the University of Minnesota. Following the class, which was led by Wayne Roberts, the six Summer Institute teachers joined the twenty NSF participants to hear a presentation by Professor Loren Larson of St. Olaf College, in Northfield, Minnesota. Dr. Larson's speech was entitled, "Some Entertaining Algorithmic Problems." The limited turnout for the seminar was attributed both to the limited number of participants who wanted the credits for completing the seminar and the cancellation of the dinner that was to have followed Dr. Larson's presentation.

Norwest Bank Tour

On October 16, 1987, during the Minnesota Education Association convention, twenty teachers attended a collaborative-sponsored tour of the Operations Center of Norwest Bank of Minneapolis. Following the tour, which began with a review of the functions of the bank's Operations Center, the teachers were served lunch in the corporate dining room. After lunch, Norwest Vice-President Gerald De Land and three other bank representatives spoke to the teachers. Sue Gifford, formerly a secondary English teacher who is currently in the bank's Human Resources Department, described the kinds of positions available in banking and the qualities that she looks for when hiring an employee. Roland Schlueter from the General Accounting Department shared some insights into the mathematics used in his department, and Gale Grutle, a former lecturer in mathematics at the university and currently Norwest's Director of Data Processing, talked about computer use in the banking industry and presented a preview of computer capabilities in the 21st century. Tour participants were unanimous in their positive evaluation of the event. One teacher commented, "These speakers were really great. I have something I can take back to the classroom. I can tell my kids I was there; I saw it." Another added, "I was doubtful about coming and I got [information] I can use."

An Evening with Sir Wilfred Cockroft

On April 11, 1988, the collaborative, the Minneapolis Math Club, and the Minnesota Council of Teachers of Mathematics co-sponsored a wine-and-cheese reception at the Port of France condominium complex in Edina for Sir Wilfred Cockcroft, who had recently been knighted for his work in mathematics reform in England. At the reception, Sir Wilfred discussed his experiences in mathematics reform during the six years that followed the publication of his report. More than 200 people attended, including approximately 150 collaborative teachers.

Discussion of NCTM Standards

Ross Taylor, Mathematics Consultant for the Minneapolis Public Schools, invited all of the St. Paul public and private school mathematics teachers to participate in discussions of the NCTM *Standards* as part of two in-service days for mathematics teachers from the Minneapolis School District. On February 22, 1988, from 8-11:30 a.m., junior high teachers met with Glenda Lappan, the chair of the NCTM working group for grades 5-8. On March 9, 1988, senior high teachers met with Harold Schoen, NCTM chair of the 9-12 working group, from 8-11:30 a.m. Collaborative teachers from St. Paul were not able to attend because school was in session.

Collaborative Newsletter

An important networking component of the Twin Cities Mathematics Collaborative is the collaborative's newsletter, *The Pentagon Papers*. The newsletter, which was first published in December, 1985, under the name "Urban Mathematics Collaborative Newsletter," continues to be a primary source of information for the entire collaborative membership. With the appointment of a teacher coordinator who could provide assistance to the editor, the newsletter was expanded to five issues annually--one during the summer of 1987 and four during the academic year. *The Pentagon Papers* is mailed to more than 400 addresses, including all UMC teachers and several industrial, business, university, college and school administrative personnel. Approximately 260 secondary mathematics teachers, including fifty private and parochial teachers, are on the mailing list. The newsletter reports on meetings and activities that have taken place and announces future activities. It also publishes the letters it receives and includes articles profiling local mathematicians. The September issue included articles on the reform of school mathematics and on the University of Minnesota Talented Youth Mathematics Project (UMTYMP).

Conferences and Workshops

In addition to sponsoring its own meetings and institutes, the collaborative sponsored teachers' attendance at a variety of regional and national workshops and conferences.

NCSSM 1987 Summer Workshop

The collaborative sponsored the attendance of two teachers at a pre-calculus curriculum workshop on July 5-17, 1987, at the North Carolina School of Science and Mathematics (NCSSM). The workshop, which was sponsored by the Carnegie Corporation, involved teachers in the study of a pre-calculus course based on an applications approach. The core of the course was composed of six modes of mathematical thought: geometry, data analysis, probability and statistics, mathematical modeling, computers, and finance. The teachers who attended were asked to pilot the material in their classrooms and to share information about the materials at a dinner meeting of the Twin Cities Math Society. They were also asked to plan a one-week institute on the materials for collaborative teachers during the summer of 1988.

NCTM Regional Conference

The National Council of Teachers of Mathematics held its regional conference in Minneapolis on November 12-14, 1987. Nearly twenty collaborative teachers organized, planned and worked at the conference. Approximately 100 collaborative teachers attended the conference; seven made major presentations. Prior to the conference, Professor Keynes, the collaborative director, sent a letter to school district officials in Minneapolis and St. Paul encouraging the districts to permit teachers to use release days to attend the conference and encouraging the districts to provide whatever financial support they could. Both districts made some accommodations by giving teacher release time, which enabled several teachers to attend. Everyone who attended the conference thought it was very worthwhile.

Forum on Quantitative Literacy

On January 28 and 29, 1988, the Minnesota Mathematics Mobilization (M^3), the Joint Committee on Statistics/Probability of the National Council of Teachers of Mathematics, and the American Statistical Association, with support from the Cray Research Foundation, sponsored a two-day conference on Quantitative Literacy. Statisticians Brian Joiner of Joiner Associates, Inc. and Gary Stork from Ford Motor Company were among the speakers who helped to provide participants with a background on new statistical materials and techniques that could be used in pre-service and in-service teacher education.

More than 100 people attended, including classroom teachers, university professors, consultants from industry and education, and representatives from professional organizations, business and industry. The collaborative Steering Committee had originally agreed to pay the $75 registration fee for up to four teachers, but teacher response was so positive that the collaborative paid the registration fee for eight teachers--two junior high and two senior high teachers from each of the two districts. These teachers were selected by their respective building representatives at a November meeting. In addition, the mathematics consultant for the Minneapolis School District arranged for a teacher from each senior high school in Minneapolis to attend the conference.

Participants' response to the conference was extremely favorable and teachers seemed motivated to instigate change. One teacher commented, "I came here yesterday and I was so excited. Today I am depressed, or at least, I was thinking about how this is all going to happen. We are so accustomed to waiting for something to happen from the top down. This will not happen from the top down. This will only happen if each one of us goes back and does it in our classrooms now. This will happen when we do it and if we wait for someone to do it for us, it won't get done and I'm going back to do it."

NCTM Annual Meeting

Approximately twelve teachers from the Twin Cities Urban Mathematics Collaborative attended the annual meeting of the National Council of Teachers of Mathematics in Chicago, Illinois, April 6-9, 1988. While the collaborative encouraged teachers to attend, it did not offer any financial support. Ed Anderson, a 1987 Presidential Award winner, used his award to send seven faculty from his school, Southwest High, to the conference.

NCSSM Follow-Up Workshop

A one-week, 30-hour workshop on the NCSSM pre-calculus curriculum for both junior and senior high school teachers was held at the Medical School campus of the University of Minnesota, June 13-17, 1988. Because the Institute ran concurrently with the NSF Summer Institute, participants had the opportunity to interact with seventy other mathematics teachers from all areas of Minnesota. Ms. Marlys Henke and Mr. Larry Luck, the two collaborative teachers who had attended a workshop on the pre-calculus curriculum in North Carolina in July, 1987, were the workshop instructors.

The curriculum, developed with support from NSF and the Carnegie Foundation, places heavy emphasis on the computer and the calculator, and attempts to address current recommendations for an updated curriculum.

Nineteen junior and senior high mathematics teachers participated in the workshop. The teachers chose whether to receive a $200 stipend or two graduate credits and a small travel stipend. Only two of the nineteen participants had ever attended a collaborative workshop prior to this event. All of the participants rated the workshop very highly. One teacher commented, "This was my first collaborative workshop and I was very impressed. It sparked my imagination and gave me new ideas to implement. I was also impressed with the positive attitude of the speakers." Another added, "We need more workshops like this which will investigate changes and advancements in all math courses, not just precalculus. There was a very positive tone." A third teacher said, "This was my first involvement in one of these workshops. It was extremely useful."

National Conference on Mathematics Reform and Teacher Professionalism

A senior high teacher and a junior high teacher, both members of the Twin Cities Urban Mathematics Collaborative, were selected by the collaborative's Building Representatives to attend the Mathematics Reform and Teacher Professionalism conference at the North Carolina School of Science and Mathematics (NCSSM) in Durham, North Carolina. The conference, held June 23-24, 1988, was designed to inform and guide the broader mathematics community in its effort to improve mathematics at the precollege level. Sponsored by the Durham Mathematics Council, with additional support from NCSSM and the Education Development Center, the conference examined the impact of urban mathematics collaboratives and other initiatives, including recent curriculum development projects and teacher training programs, on the mathematics reform movement. Participants were encouraged to understand the need for change in mathematics education and to develop strategies for bringing about that change.

Teachers who attended the conference found the content motivating and the collaborative environment stimulating and supportive. In a written summary, one teacher reported, "The conference was an excellent example of how sharing can contribute to change. Each day of the conference, time was set aside for educators to attend sessions where innovative programs were modeled by the educators using them. Informal discussions and idea sharing with other conference attendees was extremely valuable. It gave me an opportunity to establish a network with several teachers who have already exchanged curriculum plans with me. To be professionals, we have to be willing to take charge of the things that affect us. Attending a conference such as this is a great place to start."

Woodrow Wilson Summer Institute on Statistics

From June 27-July 1, 1988, the collaborative sponsored a Woodrow Wilson National Fellowship Foundation Summer Institute on Statistics at the University of Minnesota. The Institute, which focused on providing participants with new statistical techniques that could be used in any classroom, was presented by four Master Teachers who had been trained at Princeton University under the direction of the Woodrow Wilson Foundation.

The participants used simple numerical and graphical methods to process, organize and analyze real data. Topics included exploratory data analysis, sampling, probability, simulation and inferences.

Enrollment in the Institute was open to collaborative teachers, who were given registration priority, NSF Teacher Renewal Participants and other mathematics teachers in the Minneapolis metropolitan area. The response was much greater than anticipated. While minimum enrollment was set at thirty, forty-one teachers, including thirty collaborative junior and senior high teachers, participated. Collaborative teachers received either two graduate credits plus a travel reimbursement or a stipend of $200; in addition, the collaborative covered their registration fees.

The Institute was extremely successful. Participants felt that it was most worthwhile, rating it very high in terms of its practical application and the quality of its presentations. There was a great deal of positive interaction between collaborative and NSF participants. The Institute will serve as a model for sharing resources and opening the collaborative to a larger teacher community. There was, however, some feeling that some of the content was somewhat difficult. One teacher commented, "The past two months at my school have left me depressed. But Marlys' [NCSSM Follow up] workshop and this have revitalized me. I owe UMC a big thank you this summer." Another said, "I was worried about this applying to junior high, especially since I convinced two of my colleagues to come. But it does [apply] and it's good." A third teacher added, "I felt like I could have walked out after the first hour and used some of this with my kids. It's great."

E. Observations

Project Management

The Twin Cities model for collaboration provides an interesting example of a well-managed project that has evolved and matured over its three years of existence. In the first year, teachers reported that the project director was too authoritative. Now, through the Teacher Advisory Committee, teachers have major input into all decisions regarding the collaborative's operations and directions, an effective structure for self-governance. Throughout the past three years, the collaborative management has addressed issues head on, a governing body has met regularly, and necessary decisions have been made. Of special interest are the adjustments and changes that have been made in the collaborative's structure since its inception.

One change that has occurred over time has involved the role of the Teacher Advisory Committee (TAC). During 1987-88, the TAC, which is composed primarily of teachers, addressed the same issues as the Steering Committee and made recommendations to this group. This practice provided TAC members with an opportunity to address both program and policy issues, and to act as advocates for teachers' ideas--a role that was clearly defined by the collaborative at the time the TAC was established. This year, the TAC developed and proposed the concept of a Building Representatives group, which would duplicate one of its own primary functions, i.e., involving teachers in the governance structure. As the Building Representatives group developed, it became apparent that the TAC was no longer necessary. As a result, the Permanence Committee, which included a representative from the TAC, recommended that the collaborative's governing structure should consist of an advisory board and a building representative group, and that the TAC should be eliminated.

Associated with this organizational development has been the evolution of the Building Representatives group into a very active committee that meets teachers' expectations of self-governance. This group sets its own agenda, develops its own programs, and makes decisions and recommendations that influence the Steering Committee; one example is a recent Steering Committee decision to support eight teachers' attendance at a conference rather than just four. In this context, it is important to note that the Building Representatives group was established during the collaborative's third year and was not even envisioned at the outset; it is a product of the collaborative's maturation and development, a factor which may explain, at least in part, the group's rapid cohesion and functional efficiency. Members of the Building Representatives group enjoyed the benefits of the collaborative's three-year history: the collaborative had established a track record of activities that could be considered and evaluated; many of the group's members had participated in collaborative events and knew one another; and, finally, many of the teachers had been participants in collaborative activities and had been exposed to a rich array of ideas and experiences upon which they could draw. In many ways, the concept of a Building Representatives group was an idea whose time had come.

Equally important in the collaborative's development during the past year was the creation of the Permanence Committee, which established guidelines for the project's permanent structure. After appointing its members, the project director remained largely uninvolved in the committee's work. Its recommendations were accepted by vote of the Steering Committee. This was a clear departure from the process followed by the other collaboratives, where, in almost all cases, the central administration, primarily the coordinator or director, was very much involved in developing the permanence plan. As a result of the committee's independence, a broad range of alternatives were considered for the TCUMC's permanence structure, including the possibility of the project's termination. The work of the Permanence Committee was guided by an outside facilitator who had not been involved with the collaborative up to that point. The group developed a viable plan that was accepted with only slight modifications by the Steering Committee.

Despite the major changes the TCUMC experienced during the year, many key aspects of its operations remained constant. The collaborative continued to function well without a coordinator because a variety of individuals performed specific tasks that would typically have been the responsibility of a coordinator. For example, one teacher served as the teacher coordinator and, with the on-site observer, edited the newsletter as well. An outside facilitator guided the Permanence Committee. In addition, the clerical staff of the Special Programs Office for the Mathematics Department was available when needed. In previous years, fund raising had been a stumbling block; in fact, lack of adequate funds was cited as a prime reason for the project's reluctance to hire a coordinator. The issue of identifying sources for matching funds was also problematic, especially given that the collaborative is funded through a university which imposes unique administrative constraints in providing for services, allocating funds, and arranging for resources. During 1987-88, however, money did not seem to be a dominant issue. It appears that the TCUMC management structure has developed a viability to operate its current programs with a clear knowledge of the direction it wants to take in the future.

Collaboration

The TCUMC continues to foster collaboration among representatives of the schools, higher education, and industry through its dinner meetings, institutes, and workshops. Collaboration has occurred as teachers and other mathematicians have become acquainted and more willing to share ideas and information. Collaborative presentations have maintained a strong mathematics focus and have, as a result, offered opportunities for teachers and those from business and higher education to discuss the mathematical problems that arise in the world of work. This topic is somewhat removed from consideration of the mathematics that all employees need to know, or businesses' mathematical expectations of new employees or students; the collaborative has sponsored some events and activities during the year to foster discussion of these issues as well.

Asked about collaboration, teachers note their interactions with those from higher education. One junior high teacher reported that the collaborative has helped teachers establish relationships with other mathematicians: "I sense that our work at the secondary level is supported by teachers of math in higher education." Another teacher noted, "I have shared materials with two college professors! . . . I have a greatly expanded network of people (junior high to college) to talk math with, to get help from, and to give help to." Some teachers also mention the contact they have had with those from business and industry, but this type of interaction is described far less frequently than the relationships teachers say they have enjoyed with those in higher education.

The single greatest effect the Twin Cities collaborative seems to be having on mathematics teachers is their increased interaction with their colleagues. As a direct result of their collaborative participation, teachers from different schools are working together and supporting one another. One teacher reported, "I've formed a network with those across the Twin Cities. Very positive!" Another teacher commented, "[I have gotten] to know teachers outside my school very well and that has led to some of us forming a Junior High Math League for St. Paul. . . ." A junior high school teacher observed, "I use many ideas I have learned from attending UMC-sponsored workshops. I have learned much from my colleagues at other schools through associating with them at UMC functions." Asked to identify the most significant changes that can be attributed to the collaborative, this teacher described the network of mathematics teachers that has developed among different city schools, between junior high and senior high schools, and between schools in Minneapolis and St. Paul.

Although some teachers describe improved communication and better working relationships among mathematics teachers within a school, or department, this varies from school to school. Some teachers reported that they had a very interactive department even prior to their collaborative involvement. One teacher noted, "I work in an excellent math department. We have always done cooperative planning and worked well together." Another teacher made a similar comment: "I already had a good working relationship with the teachers in my school." Others feel that the collaborative has strengthened their relationships with their peers. For example, one teacher wrote, "I share much more mathematical and educational ideas with my colleagues. I am more keenly aware of the importance of doing this. [There is] less small talk [and] more professional talk of substance." Another junior high teacher reported, "There is a great deal of cooperative planning at my school. The collaborative has raised our consciousness about this."

One of the TCUMC's organizational strengths has been derived from the participation of representatives of all three sectors on the Steering Committee and at the Twin Cities Mathematics Society dinners. The relationships developing between teachers, and between teachers and those from higher education seem to be interactive rather than unidirectional, where one group serves a resource for the other. The same relationships have been slower to develop between teachers and those from business and industry.

At another level, collaboration and interaction also are occurring between the TCUMC and the districts. A mathematics supervisor from one of the districts has been very involved in the collaborative, and teachers from both districts have noted this with appreciation. The mathematics supervisor from the other district is involved as time allows. There also has been an effort by one district to invite teachers from the other to attend one of their in-services. The collaborative director has been successful in bringing to the attention of the two districts' administrations the regional NCTM conference and in obtaining release time for some of the teachers. What has not evolved is the significant involvement of either of the districts' administrations in the collaborative's planning process; it is unclear what long term effects may result because of this.

Professionalism

Teachers who have been active in the TCUMC have come to view their professional status and performance in new ways. Because of the collaborative's strong emphasis on activities devoted to increasing teachers' mathematical knowledge, teachers are learning more mathematics and becoming more confident in their teaching. One teacher observed, "[The] department is more aware of what the math community is doing." Another teacher wrote, "The sharing and visiting is adding much to my confidence in [trying new things in my teaching]. I have had two opportunities to attend conferences and have also added these ideas to my daily teaching." A third teacher commented on the effects of the collaborative on his/her daily teaching: "The effects are in the way I feel (professionally) and the new ideas for presentations and activities which I have gained from being with other committed teachers."

Equally important, the collaborative is enhancing teachers' self-confidence and encouraging them to view their work differently by bringing teachers together to create links between the two school districts. As a group that includes equal representation from each district, the Building Representatives group has helped teachers become acquainted. The Building Representatives also provide an open channel of communication among all Twin Cities teachers. Those who serve as representatives are benefitting from the experience, as noted by one teacher, "I believe my work as a contact person and becoming a more 'familiar' face has increased others' confidence levels in me."

Teachers' enhanced sense of professionalism is also evident in their increased involvement in professional meetings and organizations. As one teacher noted, "If not for the TCUMC, I would probably attend only programs offered within my department and that would be limited to regional NCTM conferences." Some teachers report that they have joined more professional organizations because of the collaborative. As one said in describing the project's impact, "As a result of information disseminated by the TCUMC, I have joined professional organizations and attended professional meetings and workshops." As part of its overall mission, the TCUMC provides a rich array of professional experiences, with a strong emphasis on mathematics, to teachers in the Twin Cities and informs them about state, regional, and national conferences. Although it encourages teachers to attend these events, the collaborative does not support this attendance financially. This is a departure from many of the other collaboratives, which provide teachers with travel stipends or small grants to help support their attendance at such meetings. Despite this, Twin Cities teachers have expressed a keener interest in professional organizations and activities, on both local and national levels.

Finally, teachers are becoming professionally empowered through their increased mathematics knowledge, through group affiliation, and through their recognition of alternative approaches to teaching. The initial stages of this empowerment are evident when teachers express dissatisfaction with the status quo and report a new interest in improvements. One teacher noted, "[The collaborative] has made me very dissatisfied with the conditions at my school--4-5 different class preparations, lack of cooperation among teachers, traveling, and other teachers unwillingness to improve professionally." This teacher continued, " . . . because of the collaborative I am willing to work for improvement [of the curriculum]." Another teacher commented, "I am much more excited about my daily teaching. I am willing to try new things--taking risks that I usually never did." The collaborative also provides teachers with a reference group from which they derive the power to approach the district administration: "My activity with the collaborative gives me more validity when I approach the administration about materials or attendance at professional meetings."

It appears that at least some Twin Cities mathematics teachers are perceiving themselves in a different way because of the collaborative, and this new perception excites them. As one teacher reflected, "I perceive myself as a greater facilitator, in the classroom, for learning. I've had great role models for this. I am a source for learning, not the source for answers!" Clearly, the collaborative has enhanced the professionalism of many mathematics teachers in the Twin Cities, particularly those who have attended the Summer Institutes and who serve as building representatives. The collaborative intends to expand its influence beyond this core group; the Building Representatives group is a part of this effort.

Mathematics Focus

The TCUMC has always maintained a strong mathematics focus centered around problem solving. During the 1987-88 school year, the collaborative continued its strong push to provide teachers with opportunities to learn more about mathematics. A number of activities sponsored by the collaborative, such as the society dinners, presented talks on mathematical topics or problems. These were balanced by other activities that focused more heavily on exploration of the mathematics curriculum and the mathematics students need to know. These activities included some of the Academic Year Seminars, the Norwest Bank tour, Mr. Taylor's discussion of the NCTM *Curriculum and Evaluation Standards*, and the meetings on statistics and quantitative literacy.

In considering the collaborative's growth and impact, three developments are worthy of note. One is the emphasis given during the year to statistics and quantitative literacy. This began with the two-day workshop in January, which was designed to provide an introduction and generate an interest in statistics, and culminated in the Woodrow Wilson One-week Summer Institute in June. The Summer Institute was an overwhelming success, as evidenced by the fact that its enrollment of forty-one surpassed that of any of the fifty-five one-week institutes conducted by the Woodrow Wilson or Dreyfus Foundations, including those in chemistry and physics, during the summer of 1988. The average attendance for the one-week Summer Institutes was twenty-seven. Teachers' comments suggested that the quantitative literacy workshop and the statistics one-week Institute will have an impact on the curriculum. One teacher who had attended the quantitative literacy workshops noted that statistics and probability will be included in the curriculum for the first time next year. She continued: "I have used a few things to enrich and make my classes more interesting. The Q. L. materials will be used a lot next year." Another teacher who had attended both events commented, "What I have learned I will share with my colleagues. We intend to incorporate this material in our curriculum."

A second development that merits discussion is the observation by some of the junior high school teachers attending the 1987 Summer Institute on a problem-solving approach to number theory that there is a difference between junior and senior high school teachers. One teacher commented that the senior high teachers can easily do problems junior high teachers forgot about years ago. To date, the collaborative has not differentiated activities to target a specific level of teachers, in large part because all of the teachers are certified to teach grades 7-12, and there is some transfer of mathematics teachers between junior and senior high schools. But the teachers' comments suggest that there may be instances when it would be appropriate to group them by grade level, or, at minimum, to plan accordingly when sponsoring a joint event.

The third development of note is that the Building Representatives, as a group, decided to focus on general mathematics for the past year. It is interesting that when teachers set their own agenda, they choose to attend to what is generally considered more traditional to the curriculum. This is in contrast to other topics addressed by collaborative events, such as statistics, pre-calculus, and algorithmic problems. This suggests some interesting questions about collaboratives. The strong mathematics-oriented topics of the society dinner presentations may be important in that they provide meaningful experience for a range of mathematics users--teachers, business people, and academicians. But at the same time, there seems to be a need for teachers to talk about some very basic issues. With its active Building Representatives group, TCUMC is now able to offer teachers the opportunity to enjoy a broadening experience in mathematics and a forum to talk shop.

What has become apparent is that TCUMC teachers are learning more about mathematics and current trends in mathematics education which is, in turn, giving them more confidence in their teaching and impacting on the curriculum. For example, one teacher noted, "I have included a significant amount of problem solving in my classes and find it much easier to diverge from the textbook curriculum. I think it has significantly improved my teaching." A second teacher wrote, "I am aware of the 'new' thinking in mathematics education and have shared this with others. We have already done some things to help implement these new ideas. . . . We have internalized the new Standards and we are changing the order in which we teach materials. . . ." Finally, a third teacher observed, "My mathematics classes are better places to learn as a result of collaborative programs. Most significant are the course offerings in mathematics (not education). Programs that have enabled many of us with common concerns to meet, talk, design, and critique curricula are made possible by the collaborative."

F. Next Steps

During 1988-89, the Twin Cities Urban Mathematics Collaborative will strive to continue to offer the highly rated activities it has developed under its current structure. These include the Building Representatives group, the newsletter, the Twin Cities Math Society, workshops, meetings on educational policy issues, and special Summer Institutes.

The collaborative also will begin its transition to a new governance structure with an eye toward permanence. A new thirteen-member governing board will be established, with the initial membership drawn from the current Steering Committee, nominees from the Building Representatives group, and new members. Ultimately, the board will prioritize activities for fund raising and budgeting and will be involved in fund-raising endeavors. The collaborative will become incorporated as a private, non-profit, tax-exempt organization by 1992. Administration should shift to a part-time executive director supported by a part-time secretary. Funding beyond the Ford Foundation grants will be sought from the school districts, private and foundation sources, and federal and other grants.

The current governance structure consisting of the project director, the Steering and Teacher Advisory committees, the teacher coordinator, and the newsletter editors will terminate as of September 1, 1988. The project director will remain the fiscal agent and will be a member of the governing board through the four-year transition period. Daily administrative support will continue under the current structure until new staff are hired.

The highly successful Building Representatives group will be reorganized to increase its visibility and impact on the collaborative, and to provide more teacher control over its activities and programs. The Teacher Advisory Committee (TAC) will be incorporated into the Building Representatives.

The Twin Cities Math Society will continue, with special attention given to encourage more participation by mathematicians and teachers from the greater metropolitan area.

Academic-year activities designed to involve teachers in content, workshops, and institutes will be supported. Workshops and activities directed towards equity and excellence issues will be a special focus.

The collaborative will also seek outside funding sources to sponsor a series of institutes similar to the Woodrow Wilson Summer Institute on Statistics and the NSCCM/NSF Precalculus Curriculum Workshop. In addition to concentrating on topics of great interest to the teachers, these workshops provide opportunities for the involvement of non-collaborative teachers.